REPRODUCTION AND SEX

# SURVEY
# OF HUMAN BIOLOGY

EDITOR S A BARNETT

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# REPRODUCTION AND SEX

by

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## EDITOR'S NOTE

In the first volume of this *Survey* to be published (Leff *Social Medicine*) the whole field of the health of human populations was reviewed In this the second volume to be published, the subject is one which has significance primarily for the individual for the parent or the lover rather than the people of a city or a country The theme is essentially the application of scientific knowledge to the problems of sexual development child bearing and sexual behaviour Dr Swyer has had experience not only of clinical research in a great London hospital but also of the diverse personal difficulties of ordinary people needing advice on some aspect of marriage or parenthood and is therefore particularly well qualified in this difficult field

The physiology of reproduction is a complex and technical subject and Dr Swyer goes into it deeply enough to interest the student but he has avoided inessential technicalities in order to make the essential facts clear to a wide public (Additional information is given in appendices not designed for the layman and there is a glossary of technical terms ) The importance of the welfare of mothers and infants and the many problems faced by married couples make the subject one on which all adults need and most wish to be well informed

Physiological studies are however not sufficient to solve all the problems we need also reliable information on the psychological or behavioural level Many of the fears and anxieties of adolescence and much marital unhappiness would be reduced if there were wider knowledge simply of the facts of sexual behaviour Here Dr Swyer has been able to use the vast collection of facts made by Dr A C Kinsey and his colleagues on the sexual behaviour of American men and women Hitherto this sort of information has been systematically acquired mainly by anthropologists studying simple societies the two Kinsey reports provide not only much new knowledge but bring it into relation with other anthropological physiological and psychological studies

By making use of the results of these and other dispassionate enquiries Dr Swyer gives the facts necessary both for a balanced attitude

towards the personal problems of normal individuals and for rational conclusions on public questions such as homosexuality and other so called perversions He shows clearly how this objective approach makes it possible to be both well informed and humane

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# I

## A PRELIMINARY OUTLINE

THE essential feature of sexual reproduction is the union of two germ cells or gametes of different sexes with the formation of a single cell which then develops into a new individual The union is part of a more comprehensive process fertilization This involves essentially the transmission of the smaller active male germ cells—the spermatozoa—to the female where they may meet the larger passive gamete—the egg-cell the penetration of the egg by one of the spermatozoa and the complicated transformations and interactions of the nuclei of these two cells culminating in the first division giving rise to the first two daughter cells of the fertilized egg or zygote

Biologically the fundamental distinction between the sexes is the ability of the male to produce spermatozoa and of the female to produce egg-cells The situation however is complicated by the existence of secondary sexual characters dependent upon the activities of the sex glands and directly or indirectly concerned with reproductive functions These characters are well developed in humans in contrast to the position in many other animal species They distinguish the sexes without reference to the germ cells the production of which might for example cease as a result of disease or accident though the sex of the individual would remain Since an individual so affected would be incapable of reproduction this simple illustration demonstrates the separateness of sex and sexual reproduction

In contrast to asexual reproduction wherein the organism simply divides into separate new individuals or buds them off sexual reproduction appears to be very complicated The questions naturally arise What is its significance and why should it preponderate in nature? Its preponderance may be taken to indicate its biological superiority this lies in the fact that it involves two individuals each liable to biological variation so that their union presents possibilities of almost infinite combinations of characters The net result is greatly increased variation

The operation of natural selection involves the elimination of some variants but the preservation of others Organisms employing sexual reproduction have thus had better opportunities for adapting themselves to their environment and so, with few exceptions have succeeded over those employing non sexual methods

### SEX DETERMINATION

An understanding of the mechanism of sex determination requires a knowledge of the chromosomes of the cell nucleus The chromosomes carry the units of heredity or genes

In the human each cell nucleus contains 24 pairs of chromosomes Two of these chromosomes the sex chromosomes, play a special part in primary sex determination In females the two sex chromosomes are similar in appearance and are called X chromosomes In males the sex chromosomes differ one being an X but the other being smaller and called Y During the development of the germ cells, various cell divisions take place in one of which the number of chromosomes is halved (reduction division) In consequence each germ cell contains only one member of each pair of chromosomes All female gametes—egg-cells—must therefore contain an X chromosome but male gametes—the spermatozoa—can contain either an X or a Y chromosome Equal numbers in fact of X bearing and Y bearing spermatozoa are produced At fertilization each gamete contributes its quota of chromosomes thereby restoring the original number If an X bearing spermatozoon fertilizes the ovum the fertilized egg will contain a pair of X chromosomes and can be expected to develop into a female If a Y bearing spermatozoon is responsible for fertilization the fertilized egg will contain both X (from the ovum) and Y chromosomes and so can be expected to develop into a male

That the above is not the full explanation of sexual differentiation is attested by the occasional occurrence of intersexes of various kinds Many factors mostly ill understood may influence the sexual differentiation of the embryo from a very early phase The free martin is an example of this In cattle it is well known that if male and female twins be born although the male calf is normal and will develop into a fertile bull the female may show certain intersexual features and fail to become a fertile cow such a calf is called a free martin The explanation offered is that hormonal influences from the male embryo affect the development of the female twin leading to abnormalities of its

sexual organs For this to occur there must be a fusion between the blood vessels of the foetal membranes of the two embryos—which explains why not all the females of male female twins in cattle are free martins

The existence of free martins is much better known by people who live in the country than by town-dwellers, and there is a widespread belief among the former that a similar situation can occur in humans

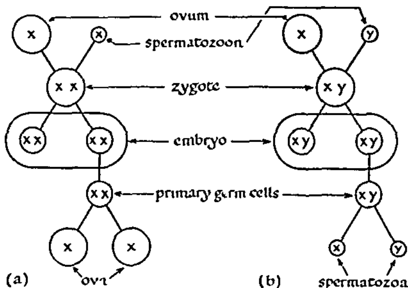



Diagram to illustrate primary or genetic sex determination In (a) there is union of an X bearing sperm with an egg resulting in an XX zygote this produces a female embryo the primary germ cells of which give rise to eggs all carrying X chromosomes In (b) there is union of a Y bearing sperm with an egg resulting in an XY zygote this produces a male embryo the primary germ cells of which give rise to sperms half carrying X chromosomes and half carrying Y

For this reason in country districts it is commonly held that women who have twin brothers are sterile This is absolutely untrue human free martins do not exist despite Aldous Huxley s *Brave New World* [48] and there is no reason to suppose women with twin brothers to be any less fertile than their untwinned sisters The position is made quite clear by Lillie [61] who states Simpson made an investigation of the subject (in 1844) which may be regarded as disposing for ever of the superstition He investigated the family history of 123 married women born twin to males of whom 112 had families and 11 had none,

he found also that this proportion of childless marriages was not greater than in the general population

### THE SEX ORGANS AND THEIR DEVELOPMENT

So far we have considered only the gametes without concern for their origin The organs wherein the gametes arise are called the primary sex organs or gonads they are the testis in the male and the ovary in the female The description primary is used to contrast them with the secondary sex organs—structures intimately concerned with the reproductive function but not the source of the gametes In the male the secondary or accessory sex organs provide for the transport of spermatozoa from the testis and for their intromission into the female In the female the accessory sex organs have more complex functions to perform they must receive the spermatozoa allow of their access to the ovum and provide for the development of the fertilized ovum Finally when embryonic development is complete they must bring about the birth of the baby and during the early post natal months provide for its nourishment A detailed description of these reproductive organs is given in Appendix I

At birth members of both sexes possess their full complement of reproductive organs though in an incomplete state of development During the first ten to fourteen years of life very little change takes place in these organs and they remain largely functionless At puberty they undergo dramatic growth and begin to function the gonads produce not only gametes but also the sex hormones which play a fundamental part in the reproductive economy and in addition are largely responsible for turning a boy into a man or a girl into a woman Indeed the gonads begin to secrete sex hormones before they produce gametes and it is now known that the sex hormones play a part not entirely understood in gametogenesis

In boys the production of spermatozoa does not lag far behind the secretion of male hormone and many boys become potentially fertile quite early in puberty In girls on the other hand effective endocrine activity of the ovary shown by the occurrence of the first menstrual period (the menarche) usually precedes the first ovulation by a considerable time often two or three years When the latter stage has been reached and the girl is now able to become pregnant she is said to be nubile (literally marriageable)

In general, a woman ovulates approximately once a month one ovum

being produced on each occasion Associated with this cyclic ovarian activity there are accompanying changes in the accessory reproductive organs, particularly the lining of the uterus (the endometrium) which undergoes changes preparing it to receive a fertilized ovum If fertilization does not take place the endometrium regresses and breaks down, bleeding takes place and gives rise to the menstrual flow Menstruation usually begins about fourteen days after ovulation

The development of sexual function which may simply be defined as the ability to engage in sexual intercourse does not closely parallel that of reproductive function Different psychological schools adopt different views on this point and while it is certain that erotic behaviour is exhibited even in early infancy, whether this is to be regarded as sexual in the most generally understood sense of the term is a matter for debate There is also no doubt that except where externally impressed inhibitions are present unmistakably sexual activities are often undertaken by both boys and girls long before they lead to reproductive results The sexual capabilities of boys are probably greatest at the time of puberty and undergo progressive diminution throughout the remainder of life—a fact which many will find surprising Girls follow a different pattern and the peak of sexual capability is reached some time after puberty

## CONCEPTION PREGNANCY AND CHILDBIRTH

By the time reproductive capacity has been attained, the ability to accomplish sexual intercourse has already been established in both sexes When coitus takes place close to the time of ovulation the resulting ovum may be fertilized and if after fertilization it becomes embedded in the properly prepared endometrium conception has occurred and pregnancy begins The earliest outward sign of this is the failure of the next menstrual period to appear

It is usual to date pregnancy from the time of the last menstrual period this is satisfactory if the woman has had regular periods occurring at intervals of about 28 days If however the periods are not so regular trouble arises when the expected date of delivery is calculated since the interval between the start of the last period and the actual day of ovulation may be very different from the usual 13 or 14 days However pregnancy usually lasts some 39 to 41 weeks from the first day of the last period

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pregnant woman, some obvious and others more obscure All of these are consequent upon the development of the fertilized ovum within the uterus they provide for its nourishment and its increasing size and at the end of pregnancy for the expulsion of the uterine contents and for the nourishment of the new born infant Among the most striking changes in the internal organs are the growth of the uterus—to keep pace with its expanding contents—and the formation of the placenta The latter is an organ which exists only during pregnancy and is de veloped within the uterus partly from the fertilized egg and partly from the mucous membrane of the uterus it enables nutrient materials and oxygen from the maternal blood to pass into the blood stream of the embryo as well as permitting the reverse transfer of some of the waste products arising in the latter The term foetus is applied when the embryo has begun to assume a distinctly human form This takes place at the end of the eighth week

The end of pregnancy is heralded by the onset of labour What deter mines the onset of labour is still obscure but the actual processes in volved in labour are very well understood Three stages are recognized the first is occupied by the gradual opening of the neck of the uterus that is dilatation of the cervix the second is that during which the uterus by its own muscular contraction aided by voluntary efforts on the part of the mother expels the infant through the birth canal and the third consists in the expulsion of the placenta (hence the name after birth given to the latter)

At a very early stage in pregnancy changes occur in the breasts pre paring them for the function of lactation Effective lactation does not begin until a few days after the birth of the baby but during these few days the breasts secrete a material called colostrum rather different in composition from milk and with less nutritive value for the baby Con sequently, it is invariable that the baby loses weight at first but with the establishment of lactation growth and weight gain soon recommence Though in some animals notably cattle colostrum is said to be an important source of antibodies protecting the new born against certain infectious diseases it is very doubtful whether it has such a value in human infants

After the delivery of the baby a variable interval elapses before men struation is resumed This may range from five or six weeks to many months and while it is true that lactation usually delays the resumption of menstruation many a surprised and chagrined mother has found her self pregnant again while still suckling her baby because she has been

under the common misapprehension that a lactating woman cannot con ceive The fact is that ovulation *can* occur during lactation and of course its occurrence will not be recognized until the period has fol lowed some two weeks later If coitus took place at the time of ovulation pregnancy might ensue even though there had been no menstrual period since the end of the previous pregnancy

### THE CLIMACTERIC

The number of the reproductive years varies a good deal in different women, but sooner or later ovarian function begins to wane Character istically the function of producing ova—ovulation—ceases before that of producing the internal secretions The reason for this is that the ovary is endowed with a certain number of potential eggs (primary oöcytes) of which there is a continual loss some by ovulation during the reproductive years but most by a process of which more will be said in chapter IV and eventually the stage is reached where no more eggs are available Consequently after the age of say 40 more and more men strual cycles may occur without ovulation (This statement may seem to be paradoxical but it will be seen later that menstruation *can* occur without preceding ovulation ) Finally when the endocrine activity of the ovary is reduced to a sufficiently low level, menstruation ceases altogether and the menopause is said to have been reached The phase of waning ovarian activity is referred to as the climacteric or change of life It may pass without undue incident, or may be a period of serious distress for the woman who is then said to be suffering from the climacteric syndrome It must be emphasized that the climacteric itself is *not* a disease but a purely physiological process only when the process becomes deranged and produces undesirable symptoms can a state of ill health be said to exist Sexual function in contradistinction to repro ductive function does not necessarily show an abrupt or even gradual termination Indeed in some women the climacteric ushers in a phase of heightened sexual desire though this is usually short lived The ability to have normal and satisfying sexual intercourse may persist indefinitely long after the menopause

In men there is no abrupt outward and visible sign of waning repro ductive potency and hence the idea of a male climacteric did not exist until comparatively recent years Such a possibility has however been mooted and some authorities believe that many middle aged men show symptoms attributable to decreasing production of male hormone by

the testes for which they believe administration of the male hormone (testosterone) is the correct treatment While it is probably true that such cases do exist it is doubtful if they are at all common In general the male shows a gradual and progressive decrease in sexual activity and reproductive ability as measured by the production of spermatozoa decreases pari passu with this There are certainly authentic cases of men over 70 years of age retaining their fertility

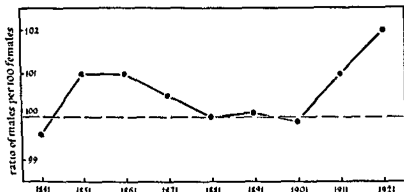
### SEX RATIOS

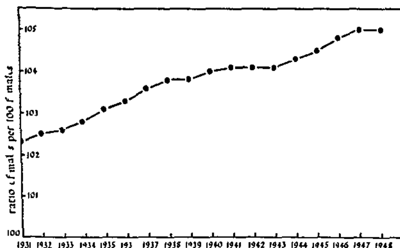
It will be recalled that spermatozoa are of two kinds X and Y bearing according to the nature of their sex chromosomes Theoretical considerations lead to the conclusion that these two kinds should be produced in equal numbers and it would therefore be reasonable to assume that equal numbers of XX (female) and XY (male) zygotes would result at fertilization That this in fact is not the case is suggested by the birth of more male than female babies Such a result could be due to the greater tendency of female than male babies to die in the uterus but since the sex ratios of foetuses aborted at various stages of pregnancy are even higher—in favour of the male—than at birth it seems more likely that the primary sex ratio is also higher than the ratio at birth The ratio at birth at present about 106 males to 100 females in England and Wales is not constant It varies with different populations and from year to year As judged by the census figures from 1841 to 1911 it would seem that the ratios had been rather close to 100 but since that time there has been a progressive rise The figures during the war of 1939–45 do not show the sudden rise in the sex ratio that has been alleged to occur during wartime but only the steady tendency to rise that has persisted during the past quarter century

Comparatively little is known by way of explanation of these variations in the sex ratio however since it seems clear that Y bearing spermatozoa have a rather greater fertilizing ability than those bearing X chromosomes and that female embryos survive better than do males it might be that improved maternal conditions are reducing the loss of male foetuses and so increasing the sex ratio at birth In Western countries at least the greater susceptibility of males to lethal agencies continues in post natal life and is shown by the progressive change in sex ratio with age

During the reproductive years this ratio approximates to 100 100 but later because of the sustained differential death rate of the sexes,

the numbers of women over the age of about 40 exceed those of men of comparable ages This excess increases progressively with increasing age

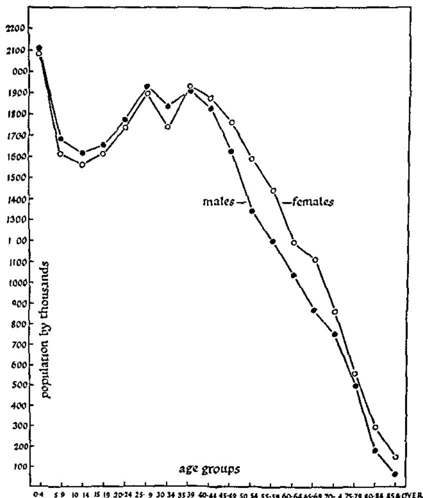



The variation in the sex ratio (number of males per 100 females) in the age group 0–4 (a) Calculated from the decennial census figures from 1841 to 1921 It will be seen that until 1901 the ratio is not very different from 100 but there after it rises and as is shown by (b) this rise has continued until 1948 The ratios in these two figures being based on the age group 0–4 will in general be lower than the ratios at birth

Little is known of the reason why more Y bearing than X bearing sperms fertilize eggs and it is clear that more precise knowledge of this matter would go a long way to making possible an alteration in the

sex ratio The social and economic consequences of such an ability are obviously profound and indeed unpredictable In animal husbandry, for example it would clearly be of great advantage to be able to breed




The male and female population of England and Wales by 5 year age groups in *1948 Below the age group 30–34 there are more males in each group than* females but in all later age groups the proportions are reversed *[81]*

a preponderance of cows let us say, in a dairy herd In human reproduction the political consequences of ability to alter the sex ratio might be frightening but if that ability were sufficiently great the social consequences could be highly gratifying in some circumstances To be able

to beget a daughter for example might be of great importance when several sons have been the results of previous reproductive efforts In spite of the interest of the subject and of a fair amount of research on it, no means of achieving this object are available

An extraordinary view still sometimes entertained is that the left ovary produces eggs which develop into females while eggs from the right ovary develop into males women who have given birth to daughters only are on this basis regarded as ovulating only from the left ovary Doubtless no woman has been seriously advised to have her left ovary removed in order to introduce a son into a family hitherto composed entirely of daughters though some women who have had a diseased ovary removed have been informed that in future they will beget only sons (or daughters as the case may be) In direct refutation of this fallacy are the many instances in which women known to have only one ovary have given birth to both sons and daughters

Various theories most of them based on the belief that X bearing and Y bearing sperms will behave in different ways in suitable circumstances have been advanced to explain the primary sex ratio and to provide a basis for attempts at influencing it All are unproved and have failed to stand the test of critical investigation Only one will be mentioned—because it is widely disseminated—namely the belief that the acidity or alkalinity of the vagina helps to determine whether more X bearing or Y bearing sperms are likely to reach the egg [*105*] On this basis the advice has often been given that a bicarbonate douche should be used before coitus if a boy is wanted The normal reaction of the vagina is quite strongly acid and to interfere with this reaction is to say the least foolhardy—as well as most unlikely to have the least influence on sex-determination To sum up therefore there is no known way of prearranging the sex of a human baby

### PREDICTING SEX

Although less intense than the desire to give birth to children of predetermined sex the wish to know the sex of the unborn baby is often expressed by pregnant women Attempts have been made to base a prediction on the hormone excretion of the pregnant mother it is fair to say that at present no conclusions can be reached by such studies The most promising line of recent investigation has been the use of the vaginal smear that is the microscopical examination of the superficial cells rubbed off the vaginal wall by means of a cotton wool or similar

applicator [73] It has been found that between the 18th and 26th weeks of pregnancy three distinct types of smear can be obtained One called cytolytic because there is considerable destruction of the substance of the superficial vaginal cells appeared to be associated with a female infant The two other types were both found to be associated with male infants They were (1) the mucoid cornified smear' consisting of fully developed (cornified) cells together with much mucoid material and (2) the glycolytic smear This second type rarely seen and in this study always associated with a male infant showed a lack of glycogen (a carbohydrate resembling starch) in the cells but its presence outside the cells

The investigators believe that the vaginal smear reflects the balance of male and female hormones a male infant being responsible for a preponderance of the former type of hormone If, however, the usual great excess of maternal hormones masks those of the foetus a cyto lytic vaginal smear will occur in the presence of a male infant In fact, this was the case with all the errors (4 out of 22) in the series Probably the most serious drawback however to this method is the fact that out of 86 pregnant patients observed, specific smears from which sex pre diction could be made were obtained from only 22 In other words 3 patients out of 4 seeking a sex forecast of their unborn babies would have to be told that no answer was given by the test while of those given an answer one out of 5 would get the wrong one As this is probably the best that can be achieved with our present limited know ledge, it seems fair to conclude that sex prediction is still little better than guesswork

# II

## REPRODUCTION IN THE MALE

ALL male reproductive activity is related to the ultimate union of spermatozoon and ovum It may therefore be regarded as con sisting of first the production of spermatozoa and the provision of the means whereby they can be ejaculated and secondly the development of behaviour which will ensure their being ejaculated within the vagina of the female For the present, we are concerned only with the first aspect

The male reproductive organs consist of the testis wherein the sperms are produced the duct system through which they have to pass on leaving the testis and the accessory glands which provide the liquid vehicle in which the sperms are ejaculated In addition there are certain muscles which play a part in ejaculation

### THE PRODUCTION OF SPERMATOZOA

The testis from the functional point of view consists of two essential parts the seminiferous tubules which produce the spermatozoa and the interstitial (Leydig) cells which secrete the male hormone The seminifer ous tubules are lined with cells arranged in several layers (germinal epithelium) The outer layer consists of primary germ cells (sperma togonia) Scattered among them are other cells the Sertoli cells which will be discussed later In the new born baby and up to puberty no later stages of sperm production are to be seen At puberty however differentiation of the germ cells begins The offspring of the primary germ cells—the spermatocytes—undergo only two further divisions (maturation divisions) and thus each gives rise to only four further descendents The cells resulting from the second maturation division are called spermatids and at this stage the formation of the tail begins It is generally believed that the spermatids become attached to the Sertoli cells in order to become the spermatozoa The details of this

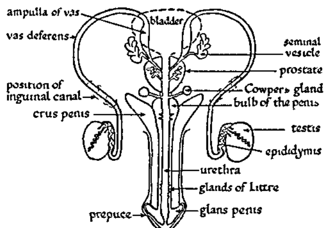



Diagram of the male genital organs

transformation are intricate the gross changes consist in great elonga tion of the tail and gradual loss of the protoplasm surrounding the nucleus

The spermatozoa leave the testis before maturation has been com pleted and the final stages are usually passed in the epididymis To reach this they pass from the seminiferous tubules of the testis into the efferent ducts which open into the epididymis The latter is a tube some twenty feet in length convoluted to an extraordinary degree from the opposite end of which emerges the vas deferens This is a continuation of the canal of the epididymis but has a thick muscular wall by the contraction of which the spermatozoa are propelled forwards during the act of ejaculation The vas deferens follows a peculiar course shown in the figure above which shows also the rest of the male genitalia

## THE TESTIS AS AN ENDOCRINE GLAND

From time immemorial it has been recognized that the maleness of a man is associated with his testes removal of which (castration) pro duces an eunuch If castration was performed before puberty the victim differs from a normal man in that his voice remains high pitched growth of the beard does not take place little or no hair appears on the pubis or in the armpits muscular power is often deficient the limbs are often abnormally long and the penis remains small like that of a boy Comparable effects are produced by castrating animals Indeed the first demonstration of the internal secreting function of any endocrine

gland was given by Berthold in 1849 when he showed that by grafting the testis of a cockerel beneath the skin of a capon (that is a castrated cockerel) the animal could be restored to the normal appearance and activity of a cockerel [14] The explanation of this effect is that the grafted testis produces a substance the male hormone which entering the blood stream is conveyed all over the body to exert specific effects upon the growth of hair bone the cartilages of the larynx the muscles the accessory sex organs and so on It is possible for the germinal epithelium of the testis to undergo destruction without the interstitial

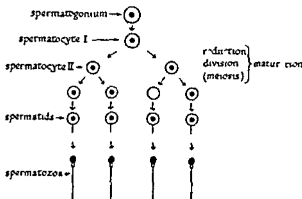



Diagram of spermatogenesis The first of the maturation divisions is the reduction division in which the chromosome number is halved

cells being affected When this happens none of the effects of male hormone deficiency is found though if the interstitial cells too are destroyed then those effects appear It is therefore concluded that the source of the male hormone is the interstitial cells which lie in small groups between the seminiferous tubules

In immature animals and in boys before puberty the interstitial cells of the testis are functionless The changes of puberty are the direct result of the action of the male hormone the secretion of which commences at this time In order to understand how this comes about as well as how sperm production is initiated and maintained, we must pay attention to another endocrine gland the pituitary body

### THE PITUITARY GLAND

This is a structure about the size of a pea which hangs like a cherry on its stem from the under surface of the brain It lies in a depression

of the floor of the brain case called the pituitary fossa It has several anatomical divisions but for practical purposes, it is sufficient to consider only two parts, the anterior and posterior lobes Our present interest is centred only in the first of these which, considering its small size seems to produce a bewildering array of different hormones that affect many of the other endocrine glands as well as the body as a whole We can summarize these hormones as follows There appear to be three pituitary hormones which affect the gonads and are therefore called gonadotrophins the growth hormone which seems to influence general bodily growth the utilization of sugars (carbohydrates) and the production of insulin by the pancreas one or more hormones which control the activity of the adrenal cortex and are therefore called the adrenocorticotrophic hormone now familiar as 'A C T H the thyrotrophic hormone which controls the thyroid gland, and possibly several other hormones about which we are less certain Because of these multifarious actions the pituitary was long ago accorded the title of leader of the endocrine orchestra by the late Sir Walter Langdon Brown More recent investigators have found the choice of title to be singularly appropriate because it seems that the pituitary itself is under a considerable measure of control by a part of the brain called the hypothalamus which on the same orchestral analogy, is now seen to assume the role of conductor However as A S Parkes has pointed out, the orchestral analogy becomes less satisfying when it is realized that some of the members of the orchestra—the other endocrine glands—exert an influence both on the conductor and the leader

### EFFECTS OF GONADOTROPHINS ON THE TESTIS

We must now return to the gonadotrophins The prevailing view is that there are at least two gonadotrophins and we will follow this in the ensuing description It is believed that the same gonadotrophins are found both in men and women The names given to them are appropriate only to the latter sex and they will therefore appear incongruous when applied to the former One hormone is called follicle stimulating hormone (F S H ) the other is called luteinizing hormone (L H ) the reasons for giving them these names will become clearer in the next chapter

Before the age of puberty the production of F S H by the anterior lobe of the pituitary gland is on a very small scale It is uncertain whether the amount is merely small or altogether zero at all events the

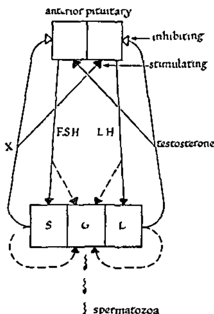
prepuberal testis remains unstimulated The basic change at puberty is the production by the pituitary of effective amounts of F S H What triggers the pituitary into activity at this time is unknown Another question still incompletely answered is whether the production of F S H just before puberty is in amounts similar to those of adults or whether they are greater theoretically as will appear shortly they would be expected to be greater and some incomplete evidence points in this direction

The precise effects of F S H on the testis are not altogether clear it certainly appears to stimulate spermatogenesis though this does not seem to be a direct action The results of many experimental investiga tions and of studies in humans with various states of damage to the testes suggest that the target cells for F S H in the testis may be the Sertoli cells These it would seem are stimulated to produce a hormone, still hypothetical which exerts an action on the germinal epithelium causing it to proliferate at the same time the hormone evidently exerts an action on the anterior lobe of the pituitary causing it to produce less F S H This sort of reciprocal relationship between pituitary and target organ is typical the secretion of the target organ preventing the overproduction of the pituitary hormone Consequently when the target is removed or rendered functionless by disease the pituitary produces an excess of the hormone in question

So it is with the testis Castration is followed by an excessive out pouring of F S H the same excess is produced if the testes though present are unable to respond to F S H Therefore in the abnormality of development called primary hypogonadism in which the testes re main small and inactive because of a fault lying in the testes themselves F S H is present in excess The sort of evidence which locates the production of the hypothetical hormone (called X hormone by Albright and his colleagues [*47*]) in the Sertoli cells is the observation that only when these are virtually eliminated by disease or otherwise does F S H appear in excess

It is thought that X hormone in addition to inhibiting the pro duction of F S H by the anterior lobe of the pituitary may encourage the release—if not the actual production—of the second gonadotrophin L H This stimulates the interstitial cells which produce the male hor mone testosterone This too probably has three actions for our present consideration It plays a part in spermatogenesis it inhibits the over production of L H by the pituitary and it may stimulate the produc tion of F S H by that gland This scheme of the interrelationship of

pituitary and testicular hormones in spermatogenesis is shown diagrammatically below If this complicated arrangement is correct it would seem that for the initiation and maintenance of normal spermatogenesis at least two pituitary gonadotrophins F S H and L H and two testicular hormones, X hormone and testosterone must be pro-




Hormonal relationships of the testis and pituitary gland The latter is represented as having two functional compartments producing follicle stimulating hormone (F S H) and luteinizing hormone (L H) The former it is thought acts on the Sertoli cells of the testis (S) causing them to secrete the hypothetical X hormone This substance inhibits the production of F S H but promotes the secretion of L H which acts on the Leydig cells of the testis (L) causing them to secrete the male hormone testosterone This inhibits the secretion of L H but probably promotes the secretion of F S H Testosterone and X hormone together act upon the germinal epithelium (G) to promote spermatogenesis though an alternative possibility shown is the direct action of F S H and L H on the germinal epithelium (After Howard *et al* [47])

duced in correct and balanced amounts It is very likely that certain other hormones such as the thyroid hormone and certain of the adrenocortical hormones must also be present in normal amounts while if female sex hormones (oestrogens) are present in excess damage to the testis may result This latter condition can arise if the liver is diseased and so unable to inactivate the oestrogens normally produced by males

At first sight it may seem extraordinary that female sex hormones should be present in males the fact is that they seem to occur in quantities which are not very different from those found in females Indeed the urine of stallions and their testes too are among the richest sources of oestrogens One of the sites of production of oestrogens in both sexes is the adrenal cortex (about which more will be said later) another in men is the testis (though not to anything like the extent in stallions!) There is some reason to suspect the Sertoli cell as the producer of testicular oestrogens tumours are known to occur in both men and women arising it is thought from Sertoli cells and these tumours may secrete oestrogens In fact it may be that X hormone is an oestrogen making the analogy between males and females even closer The reader will not now be surprised to learn that females produce male hormones in considerable amounts the sites of origin being the adrenal cortex again and the ovary

### THE MALE HORMONE

We must now consider the male hormone produced by the interstitial cells of the testis and its functions A large number of substances (more than 40) mostly synthetic compounds belonging to the chemical group known as steroids have been shown to influence development in the direction of maleness and are therefore called androgens In normal human tissues and body fluids at least six such substances have been isolated The most active naturally occurring androgenic substance in biological tests is undoubtedly one called testosterone and this is generally believed to be the natural male hormone arising from the interstitial cells

Testosterone is the principal agent whereby the changes of puberty are brought about in the boy It causes an increase in the rate of growth of the body as a whole including the bones and muscles It encourages the laying down of protein and therefore causes nitrogen retention Although it stimulates the growth of the long bones it also as part of the growth picture brings about the closure of the growing points of the bones (epiphyses) For this reason premature puberty in a boy is characterized by rapid growth the boy being above the average for his age followed by an early cessation of growth so that he ends up shorter than the average His proportions will be such that his height exceeds his arm span and his upper measurement (from the top of the head to the pubis) exceeds his lower (from the pubis to the soles of the

feet) In normal adults these proportions are approximately equal In males deficient in male hormone (eunuchoids) because the epiphyses remain open too long the proportions are usually reversed, the span *exceeding the height and the lower measurement the upper* At the same time the musculature is usually poorly developed

Other generalized effects of testosterone are promotion of the growth of hair in the pubic region on the face and to a variable extent, on other parts of the body (it does not promote growth of scalp hair but rather encourages it to fall out) stimulation of growth of the cartilages of the larynx, leading to deepening of the voice and stimulation of the activity of the sebaceous glands of the skin (which thickens under its influence) This last effect is partially responsible for the more common occurrence of acne in men than in women Testosterone has marked actions on the emotional state but we will return to these later

Before puberty the *accessory sexual organs* comprising the penis scrotum epididymis and the various accessory glands are all small and so far as the glands are concerned virtually inactive Testosterone causes striking growth in all these structures Under its influence the glands begin to secrete the material which forms the fluid part of the semen—the seminal plasma

Males who have always been deficient in male hormone show characteristic deficiencies of behaviour There may be lack of assertiveness initiative and ability to concentrate while endurance mental as well as physical is usually of a low order On the other hand an artistic type of creativeness may be shown With excess of male hormone a caricature of normal masculinity may be produced with a restless continual attempt to start new projects none of which is ever completed A well known experiment which illustrates the effect of testosterone in promoting aggressiveness is that of altering the peck order in domestic hens by its means It can usually be observed that in a group of hens housed together a definite peck order is soon established wherein number one hen will peck all the others but not be pecked herself number two pecked only by number one will peck all but her and so on down to the last hen in the order who pecked by all the others herself pecks none of them Administration of testosterone to this hen will cause her to ascend rapidly through the peck order ultimately to emerge number one Suitable gradation of doses may achieve a complete reversal of the original order

Testosterone will increase libido that is the desire for sexual activities and it will promote erection of the penis in males whose own

production of male hormone is deficient Given to males with normally functioning testes it will produce no appreciable effects This point is of great practical importance because most men complaining of deficiency of libido or of impotence (the inability to achieve erection) have normally functioning testes Hormone administration in these cases is correspondingly disappointing As will be seen in a later chapter these complaints are nearly always of psychological origin so that the failure of testosterone is not surprising The normal occurrence of libido and potency in some eunuchs (men from whom the testes have been removed surgically) shows that male hormone is not the only factor in determining their manifestation

ERECTION AND EJACULATION

The function of the penis as an organ of intromission requires its conversion from the flaccid to the erect state Erection is brought about by a rapid inflow of blood into the cavernous spaces in the erectile tissue of the penis For this to occur relaxation of the helicine arteries, through which the blood flows into the cavernous spaces must take place As the cavernous tissues fill with blood under pressure the veins which in the flaccid condition provide the outflow are compressed hindering the efflux of blood In this way the organ enlarges and stiffens

The nervous basis for erection is provided by a spinal reflex action whereby various appropriate stimuli such as touch can cause erection (as can be demonstrated experimentally in animals in which the brain has been destroyed) Superimposed upon this basic reflex arc are the effects of impulses from the higher nervous centres by means of which many other stimuli such as sight smell sound as well as the results of purely cortical activity such as thought memory and so on can cause erection At the same time, many stimuli acting through the association areas of the brain can exert an inhibitory effect on the erection reflex either preventing its occurrence or abolishing it once it has begun This inhibitory mechanism is held responsible for most cases of impotence It also provides the means whereby some control of a voluntary nature can be exercised so that for example whereas in some circumstances various stimuli may evoke erection in others where erection would be undesirable it can be deliberately prevented Involuntary inhibition of an erection in progress may result from disturbing influences of all sorts occurring at an inopportune moment

A further important factor affecting erection is the presence of male

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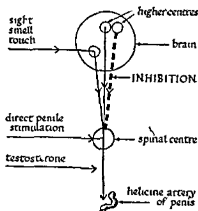
respiratory rates increase and blood pressure rises there is a general development of muscular tensions throughout the body and rhythmic movements especially of the pelvic region occur and increase in speed At the climax or orgasm the tensions are released ejaculation occurs and the body then rapidly returns to a normal state Ejaculation like erection is brought about primarily by a spinal reflex and requires the intervention of no nervous centres higher than those in the spinal cord Once the reflex has been set in motion it is beyond the reach of voluntary inhibitory control In this it is unlike the subjective accompaniments since these can be enhanced or hindered by influences acting on the higher centres of the brain Preceding the actual ejaculation the stimuli which will eventually produce it cause reflex increased secretion of the accessory sex glands so that in some men clear fluid (mainly derived from the glands of Littré) may escape from the urethral meatus The discharge of impulses from the spinal centre eventually causes rhythmic contraction of the vasa deferentia seminal vesicles and prostate thereby expelling the contained spermatozoa and accessory secretions The seminal fluid so formed is ejected from the urethral opening (meatus) in a series of spurts, varying in number from 2 or 3 to perhaps a dozen The first spurt is usually devoid of spermatozoa, being composed chiefly of secretions from the urethral glands (Littré) and Cowper s glands An intermediate fraction of the ejaculate is rich in spermatozoa The remainder consists mostly of prostatic secretion and may be almost devoid of spermatozoa

The forceful nature of the first part of the ejaculation is due to the contractions of accessory muscles which compress the root of the penis At the same time the sphincter muscle at the base of the bladder contracts thus preventing the back flow of seminal fluid into the bladder Very occasionally apparent failure to ejaculate (in spite of a normal orgasm) may be caused by the failure of this muscle to contract appropriately the condition can be diagnosed by examining the urine voided shortly after an orgasm when live spermatozoa will be found

In normal circumstances the stimuli which eventually produce ejaculation arise from friction between the penis and the vaginal walls during intercourse, but many other stimuli may contribute to the end result Indeed in some individuals ejaculation can result from erotic stimulation of various sorts if sufficiently intense in the absence of actual coitus or other direct stimulation of the penis

The subjective accompaniments of erection and ejaculation are very susceptible to inhibitory or reinforcing effects from various sources so

hormone Erections occur in boys long before puberty and in eunuchs and males whose testes have never developed properly (eunuchoids) hence testosterone is not essential for erection On the other hand many eunuchoids complain of infrequent and imperfect erections which are rendered normal by appropriate treatment with testosterone Moreover if given in excessive doses, testosterone may induce a state of more or less continuous erection (called priapism) On the other hand the administration of testosterone to men who are impotent but who




The physiological basis of erection Direct stimulation of the penis acts via a spinal reflex it is reinforced by stimuli such as sight smell thought etc acting via the brain and spinal cord but can be overidden by inhibition from the higher centres of the brain The final common path of all these influences passes via the pelvic parasympathetic nerves to the helicine arteries of the penis When these dilate the blood flow to the cavernous spaces is greatly increased and erection follows It is probable that testosterone acts at some point in the final common path augmenting the influence of the nervous system for this reason where inhibition prevents erection as in psychological impotence testo sterone is devoid of influence

secrete normal amounts of male hormone is almost invariably without any effect whatever It would seem therefore that testosterone facili tates the normal erection reflex reducing the threshold of the stimuli necessary to excite it it is powerless however to overcome the effects of inhibition exerted by the higher centres and it is quite clear that these inhibitory stimuli are prepotent since coming in circumstances which have already excited erection they can abolish it

When the stimuli which excite erection are sufficiently intense and sufficiently prolonged they set in train a remarkable series of nervous and muscular effects culminating in orgasm and ejaculation Pulse and

though to a frequency which might seem unduly low for the individual concerned, can fully restore fertility

Another effect of abstinence in addition to permitting a temporary increase in coital frequency is to speed up the attainment of orgasm This effect may be so pronounced as to lead to the embarrassing and unsatisfactory condition of premature ejaculation Thus is often encountered at the beginning of a marriage and if not tackled sensibly may lead to disastrous emotional consequences Commonly through the fear of failure at the next coital attempt either impotence is experienced or else postponement of the attempt too long again causes premature ejaculation The remedy is obvious after a premature ejaculation intercourse should be attempted again as soon as an erection can be achieved and will then rarely fail A sensible understanding attitude on the part of the wife is clearly also of great assistance

## SEMINAL FLUID

The fresh mixed ejaculate is a slightly yellowish opaque viscid fluid, averaging about a teaspoonful *(3 5 ml ) in volume (volumes up to 15 ml* have been recorded) with a peculiar and characteristic odour The semen consists of two parts the spermatozoa and the liquid medium in which they are suspended (seminal plasma)

The precise function of the seminal plasma is not clear At first sight it seems obvious that this function is to provide a medium for the transfer and nourishment of the spermatozoa but as has already been stated the spermatozoa are for the most part ejaculated independently of the bulk of the plasma Moreover there is good reason to believe that most at any rate of the spermatozoa which will succeed in entering the cervical canal and proceeding onwards towards the ovum reach the canal within a few minutes (or even less) of ejaculation Therefore although the plasma seems to be well suited to maintaining the activity of the spermatozoa we cannot assume that all the substances it is known to contain actually have this function Among the more important of these substances are fructose (derived from the seminal vesicles) and citric acid (from the prostate)

The spermatozoa use fructose as a source of energy for motility experimentally it has been shown that they can utilize glucose just as well and indeed it was long thought that the sugar of seminal plasma was glucose It is thanks to the elegant researches of Mann that we now know that this belief was incorrect *[69]* Attempts to correlate the

that whereas in ideal circumstances they are intense in unfelicitous situations they may be almost absent During the progress of normal satisfactory coitus an increasing sensation of tension is experienced corresponding to the actual muscular tensions mentioned above, these reach a climax at the moment of orgasm, and are followed by a corresponding sense of relaxation usually accompanied by a desire for sleep The pleasurable sensations, usually of a moderate degree at the beginning of coitus build up shortly before orgasm and reach a series of maxima corresponding with the rhythmic contractions of the muscular structures involved in ejaculation only to subside more or less rapidly immediately afterwards

After ejaculation it is usual for the penis to return to its flaccid state (though in some individuals in particularly erotic circumstances erection may be maintained and later a further ejaculation may occur) After orgasm the nervous stimuli which caused relaxation of the helicine arteries cease so that when the normal state of the arteries is restored the pressure of blood in the cavernous spaces falls (the blood leaking out through the veins) Once the pressure is reduced, the compression of the veins is relieved and the outflow of blood increases rapidly the penis returning to its resting size and condition

Great variability is shown by different individuals, and by the same individual at different times in the frequency with which he can ejaculate Using this as a measure of sexual potency it can be said that in general such potency is greatest about the time of puberty and gradually wanes throughout the rest of life Physical fatigue uncongenial surroundings and malnutrition as well as causing decreased sexual desire will also diminish sexual potency or even lead to complete impotence In normal circumstances the potency of an individual is conditioned by the frequency of intercourse itself since abstinence will increase it while frequent intercourse will decrease it It is very unlikely that any physical harm can ever result from so-called sexual excess since before such harm could occur the individual would have reached a stage wherein he would no longer be able to obtain an erection or to ejaculate But whereas one man may be able to ejaculate regularly more than once a day another may be unable to do so more than once a week These are basic individual variations without any necessary connotation of excess in the first case or of deficiency in the second Nevertheless though a high frequency of intercourse may be harmless in other respects by depleting the spermatozoan content of the ejaculate it can be responsible for infertility in such circumstances limiting intercourse even

more than 185 million moving spermatozoa and a specimen ejaculated on the following day contains more than 80 million moving spermatozoa Second relative fertility the first specimen (produced as above) contains between 185 and 80 million moving spermatozoa the second specimen less than 80 million moving spermatozoa Third subfertility in the majority of seminal specimens examined there are fewer than 80 million moving spermatozoa

Other authors disagree with these conclusions One theoretical objection for example is that when the seminal fluid is diluted to make the count some of the moving spermatozoa will be inactivated by the diluting fluid the proportion so inactivated varies considerably from one specimen to another and probably has nothing whatever to do with its potential fertility

An extensive study has been made by MacLeod [*63*] with the object of obtaining objective data on the sperm counts of men of proven *fertility as compared with those of men with fertility problems* He investigated 1 000 men from each group and his findings may be summarized as follows About 5 per cent of the men from the fertile group had sperm counts consistently below 20 millions per ml For the purposes of comparison he assumed that sperm density had *no* effect on fertility if this were true then at different levels of sperm density there would be approximately equal numbers from the fertile and infertile groups In fact below 20 millions per ml there were far more cases from the infertile group though above that level the contributions were similar He therefore concluded that 20 millions per ml is a critical level below which infertility is likely to be shown He next treated in the same way the estimate of the proportion of the moving spermatozoa *in the ejaculate and the quality of motion a striking difference was now* shown the higher the level of sperm activity the more likely was the ejaculate to be fertile Similar findings were true for the proportion of normal to abnormal spermatozoa in the ejaculates The conclusion was therefore reached that provided the sperm density was in excess of 20 millions per ml excellence of activity gave the best indication of potential fertility Once again therefore in general agreement with the views of Farris the emphasis is on the numbers of normal moving spermatozoa rather than total numbers [*83*]

Much effort has been expended in classifying the various morphological types of spermatozoa seen in stained films made from seminal fluid The lengths to which many authors have gone seem to be quite extraordinary Some, for example try to draw conclusions on the quality

fructose and citric acid content of the seminal plasma with the fertility of the semen have not yielded clear cut results though it appears that more highly fertile semen tends to have a rather low fructose and a rather high citric acid content [44]

The numbers of spermatozoa present in the seminal fluid vary enormously in different individuals, and also a good deal in the same individual at different times The length of time elapsing since the last ejaculation has a good deal to do with this variability, but it has often been thought that if this period of abstinence is constant the sperm content of the ejaculate should be fairly constant too There is no doubt that in general this is untrue For estimating the fertility of men most workers have advocated a three day period of abstinence before the production of a seminal specimen for testing because it is found that in the majority of married couples the frequency of intercourse is about twice a week Farris [32] contends that for many men this period is too short and that *after five days of abstinence the number of spermatozoa* ejaculated is more nearly maximal the variations from one specimen to another then being much less Even with the five day period however the fact remains that specimen to specimen variability is still marked in some individuals

In different individuals the density of spermatozoa in the semen may range from zero to 700 million or more per millilitre Men who consistently have no spermatozoa present are obviously completely sterile but with regard to the minimum permissible numbers compatible with fertility there is much difference of opinion The older views, which are still repeated from text book to text book, held that conception was unlikely to occur if the sperm density was much less than 50 or 60 millions per ml Nearly all modern workers in this field reject this idea completely and point to their experiences wherein men producing as few as 2 or 3 million spermatozoa per ml have on occasion brought about conception Of recent years serious attempts have been made to establish objective criteria on which male fertility can be based and although different authors have used different standards and methods of approach to the problem a synthesis of the findings shows considerable agreement on the main points

In assessing seminal fluid Farris [32] takes the view that the most important single criterion is the total number of progressively moving spermatozoa and as a result of his investigations he has defined three degrees of fertility in the male

First high fertility the semen after five days abstinence contains

have expected that these men—or some of them—would have had abnormal sperm morphology [*102*] In MacLeod s [*64*] recent and very extensive studies no connexion between abortion and seminal abnormalities could be found indeed with rising seminal excellence there seemed to be an increasing number of abortions but this was doubtless simply due to the greater number of pregnancies in these cases In recent studies by Bender [*13*] from Liverpool on the outcome of pregnancy in previously infertile women the abortion rate was thought to be at least double that expected for pregnancies in general but once again, no connexion with seminal abnormalities could be seen

of semen by comparing the differential count of abnormal forms to the differential count of white blood corpuscles But morphologically ab normal spermatozoa result from defects in their development and maturation and there is no evidence that this has any connexion with the different classes of white corpuscles found in the blood Since morphologically abnormal spermatozoa are far less likely to effect fertil ization than normal ones it follows as has already been said that what matters is the number of normal spermatozoa which have a chance of reaching the ovum On these grounds alone therefore it may well be argued that differentiating the *kinds* of abnormal spermatozoa is of little more than academic interest Consequently we will give only a brief indication of the common findings in seminal fluid

Depending upon the strictness of the criterion of normality, different workers have varying ideas regarding the permissible proportion of normal spermatozoa, ranging from about 90 per cent to 60 per cent the latter figure applying to those who regard all spermatozoa not con forming to the well recognized pattern of normality as abnormal Abnormalities may take almost every conceivable form and as stated above little of value is gained from elaborate classifications There may be giant spermatozoa often with misshapen heads (amorphic) pin heads which actually have no heads at all and therefore no nuclear substance so that they are certainly incapable of fertilization though they often move rapidly round heads tapering heads bent mid pieces cytoplasmic collars typical of incompletely matured spermatozoa the extreme being the spermatid wherein extensive cytoplasm surrounds the nucleus and the tail is short and duplicate forms either with double heads or double tails

One of the reasons which have been put forward for taking a detailed interest in abnormal sperm morphology is that semen with increased proportions of abnormal forms may if succeeding in causing fertiliza tion lead to the development of abnormal embryos which sooner or later are aborted In other words the possibility of the male being responsible for repeated miscarriages has been mooted and indeed this view has been widely entertained No reliable studies however support it and all the available evidence is against it It has already been stated that it is highly probable that few if any abnormal spermatozoa can reach the ovum and doubtful if any could effect fertilization The author s own seminal studies on the husbands of wives who had re peated miscarriages showed in almost all cases, entirely normal find ings whereas if the view under consideration were correct one would

functional types those which affect the way in which the body deals with sugars (these are called gluco-corticoids and include the now well known cortisone) those which affect the balance of certain minerals particularly sodium and potassium (these are called mineralo-corti coids) and those which in their actions resemble the sex hormones Although further attention will be directed mainly to this third group the general physiological importance of the first two requires a little more explanation

*The vital function of the adrenal gland seems to depend mainly if* not wholly on the hormones of the types which control sugar and mineral metabolism Experiments on animals deprived of the adrenal cortex on both sides have shown that the mineral regulating hormones have the greatest effects in prolonging life but in the absence of the sugar regulating hormones the blood sugar is so unstable and can fall so low that consciousness is easily lost One of the principal actions of the sugar regulating hormones is to break down body protein with the liberation of sugar which accumulates in the blood this happens in Cushing s disease in which there is an overproduction of these hor mones and it is also an early though transient, response to almost all forms of severe stress *such as surgical operations acute illnesses or* injuries to the body

The adrenal hormones of the third group act either like male hormone or female hormone The amounts of the latter which the adrenal gland produces are, in ordinary circumstances too small to have any striking effects The male type adrenal hormones (androgens) are probably of more importance in normal people This is not because of their mascu linizing effects (which become manifest only in special circumstances) but because they have effects which are in some ways antagonistic to those of the *sugar regulating hormones* Whereas the latter cause the destruction of protein with the consequent loss to the body of nitrogen the male-type hormones favour the building up of protein and so cause retention of nitrogen

The adrenal androgens have as part of their chemical structure a ketonic group attached to the 17-carbon atom of the steroid nucleus or are converted in the body into substances having this group substances *with this structure are called 17 ketosteroids By the measurement of* 17 ketosteroids in the urine, some idea of the androgenic activity of the adrenal cortex can be gained *Before puberty it is very low* and similar in both sexes It rises slowly during the two or three years preceding puberty and rapidly during it This marked increase in the activity of

# III

## THE ADRENAL CORTEX

ANOTHER endocrine gland which among its many functions plays a part in reproductive processes is the adrenal (or suprarenal) gland There are a pair of these structures each in shape resembling a cocked hat and lying just above the kidney of its own side They are provided with a very rich blood supply Each gland consists of two parts an outer cortex and an inner medulla of different embryological origins The former arises from the same embryonic tissue as that in which the gonads develop and it is therefore not surprising that it has a physiological relationship to them in later life The latter arises from the same source as a part of the nervous system (the sympathetic) and acts in conjunction with it

The adrenal glands are essential to life by reason of the hormones which they secrete It has long been established that the cortex not the medulla is the part which has this vital function The medulla under the influence of the sympathetic nervous system secretes into the blood stream a substance called adrenalin this hormone has widespread actions which can be generalized as those which have a defensive value to the animal being called forth in conditions of alarm The characteristic reaction of a cat on seeing a dog for example is largely due to the sudden flooding of the organism with adrenalin The adrenal medulla however plays no direct or special part in reproductive physiology and need not detain us further

The adrenal cortex produces a bewildering array of substances which recent chemical research has shown belong to the same class of compounds as the male and female hormones namely the steroids By means of these hormones the adrenal cortex exerts a profound influence on many aspects of the body s economy No simple account of the physiology of the adrenal cortex is possible and even the following which is scarcely a skeleton may seem rather abstruse

The hormones of the adrenal cortex can be grouped into three main

# IV

## THE FEMALE REPRODUCTIVE CYCLE

THE female reproductive organs (described in detail in Appendix I) comprise the internal genitalia—the ovaries (which correspond to the testes in the male) the uterus or womb with its uterine or Fallopian tubes through which ova produced by the ovaries can enter into the cavity of the uterus and its cervix by which that cavity communicates with the vagina and the external genital organs which include the mons pubis labia majora labia minora clitoris (corresponding to the penis in the male but vestigial and without essential function in the female) and the vestibule of the vagina with its glands Of special concern to us in this chapter are the ovaries and the lining of the uterus (the endometrium) by reason of the part they play in the menstrual cycle

In young girls before the age of puberty all the reproductive organs are in a rudimentary and essentially functionless condition A relatively unimportant exception to this statement can be made for in the new born infant certain evidences of activity of the reproductive organs can sometimes be seen These will be referred to later The differences between boys and girls during the prepuberal phase are therefore less than at any other time and may be regarded as due to the genetic differences between the sexes (and perhaps to the activities of the gonads during the foetal stage)

### THE OVARIES

The ovaries consist of two main parts the stroma and the ovarian follicles (Graafian follicles) The former has a supporting function while the latter are associated with the ova or egg-cells Follicles are present in enormous numbers in the ovaries of children mainly in the deeper parts of the ovary at that stage In new born girls there is also a great hypertrophy of the interstitial elements of the ovary the precise significance of which is unknown This gradually subsides during the first six

the adrenal cortex is called the adrenarche and corresponds with the outburst of gonadal activity at puberty The testosterone secreted by the testes after puberty is partially converted into 17 ketosteroids consequently the 17 ketosteroid output of men being made up partly of adrenal cortical substances and testicular substances, is usually higher than that of women who of course lack the latter Nevertheless the difference is not all that great and there are many normal women who appear consistently to excrete larger amounts of 17 ketosteroids than do some normal men

In a later chapter we shall see how the abnormal production of hormones by the adrenal cortex can be responsible for certain abnormalities of sexual development and differentiation

lation upon a causal association and it is known that light, particularly in the matter of the duration of daylight affects the reproductive rhythm in some animals, such as the ferret Nevertheless no acceptable evidence of association of the menstrual rhythm of women with external rhythms has ever been adduced It is generally agreed that the control of the rhythmic function depends on the hypothalamus and pituitary gland There is some evidence suggesting an inherent rhythm both in the adrenal cortex and the ovary as well but these latter rhythms, if

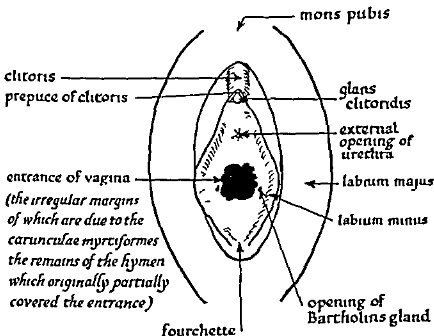


Diagram of the female external genital organs

they exist would appear to be of less importance than the first How this rhythm is translated into the occurrences of the menstrual cycle must now be explained

The rhythmic activity of the hypothalamus and pituitary normally develops shortly before puberty At this time the pituitary gland begins to secrete gonadotrophin into the blood stream The question of the number and kinds of gonadotrophin has already been raised in chapter II here we will merely follow the most generally accepted though not necessarily correct view that initially the gonadotrophin

years The primitive follicles remain either unchanged or show degenerative changes during the prepuberal period Indeed, most of the primitive follicles disappear through this degenerative process (atresia) only a small proportion—perhaps 400 out of 400 000—are destined to take

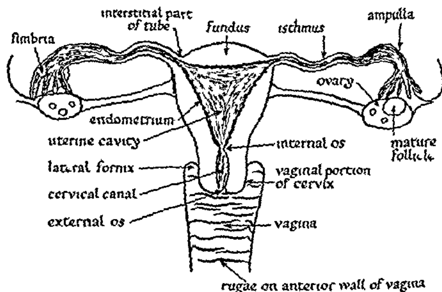



Diagram of the female internal genital organs seen from behind the uterus tubes and vagina cut so as to show the interior

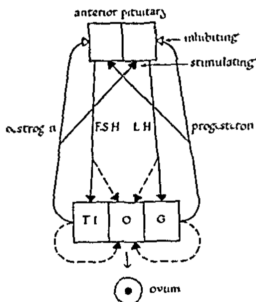
part in ovulation The term oogenesis is applied to the actual formation of ova (cf spermatogenesis in the male) In contrast to spermatogenesis which is essentially a function of sexually mature males the production of egg-cells is probably purely a foetal activity [65–8 92]

## OVULATION AND THE MENSTRUAL CYCLE

The liberation of mature ova from the ovary unlike that of mature spermatozoa from the testis is a discontinuous or cyclical process For this reason since ovulation is associated with a whole series of other accompanying changes female reproductive physiology is characterized by its fundamentally cyclic nature of which the most obvious outward evidence in women is the menstrual cycle

Just what determines the periodicity of the female reproductive organs is uncertain The correspondence of the most usual cycle length with that of the lunar month has from time immemorial invited specu

no useful purpose whatsoever, beyond indicating when they occur reasonably regularly, the probability that the reproductive apparatus is functioning properly Even in this respect they can be misleading since apparently normal and regular menstruation can take place in the absence of ovulation This as has been explained is usually the case with the first period and it is also true of subsequent periods




Hormonal relationships of ovary and pituitary gland (compare figure on page 18) F S H produced by the pituitary acts on the theca interna of the follicle (T I) which secretes oestrogen this tends to inhibit the production of F.S H but stimulates the secretion of L H by the pituitary L H acts on the granulosa cells of the follicle (G) leading to the formation of progesterone which acts back on the pituitary inhibiting L H secretion but stimulating that of F S H In the induction of ovulation (O) two possibilities are repre sented either F S H and L H together act directly to cause release of the ovum, or their actions are mediated by oestrogen and progesterone

during the first few years after the menarche Presumably during this time the intensity of ovarian stimulation is insufficient to lead to the full development of Graafian follicles and the liberation of their con tained ova Eventually, however this stage is reached, now it is gener ally supposed the increasing amounts of oestrogenic hormone produced by *the ovary react upon the pituitary gland so as to cause the latter to* liberate a second gonadotrophin luteinizing hormone (L H) This

secreted is follicle stimulating hormone (F S H) The amounts of this at first are small but they exert effects on the ovaries bringing about the growth and enlargement of some of the follicles The fact that development of the breasts and the beginning of the differentiation of the general bodily configuration are seen to occur before puberty itself, leads to the conclusion that female sex hormone is secreted by the ovaries of prepuberal girls This is because, with successive waves of F S H production sufficient follicle development eventually occurs for the secretion by the follicles of the oestrogenic ovarian hormone At the same time oestrogenic stimulation leads to enlargement of the uterus some development of the endometrium (the lining membrane

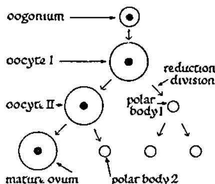
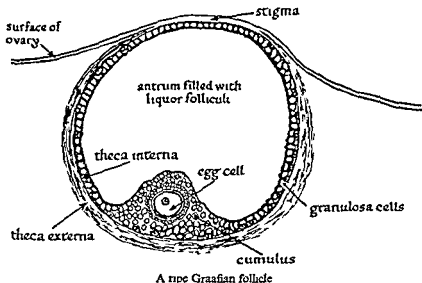



Diagram of development of the egg cell The first maturation division results in the halving of the number of chromosomes It and the second division involves the casting out of a polar body —a small non functional cell The first polar body may divide into two

of the uterine cavity) and growth of the external genital organs When the cyclic secretion of oestrogen by the ovary reaches a level high enough to produce a critical degree of development of the endometrium regressive changes occur in the latter as the oestrogen level wanes and bleeding takes place This blood oozes into the cavity of the uterus whence it flows through the cervix and vagina to appear as the first menstrual flow or menarche

The first menstrual bleeding is thus nearly always the direct result of a falling oestrogen level due to cyclically decreasing pituitary stimulation of the ovaries It has nothing whatever to do with getting rid of waste products getting rid of too much blood which would otherwise go to the head and make one mad or any similar speculations This point cannot be overemphasized Menstrual periods serve

Within a few days of the beginning of the menstrual period that is by about the third or fourth day of the new cycle enlargement of several follicles commences in both ovaries Soon one far outstrips the others the latter subsequently regress The follicle which is singled out for ovulation (what determines this selection is quite unknown) approaches the surface of the ovary as a result of growth changes in the surrounding tissue, the follicle itself of course has no apparatus for self propulsion Its blood supply greatly increases except for one projecting area on the surface, the stigma at which point the follicle will rupture during ovulation



A ripe Graafian follicle

As the time of ovulation approaches changes begin in the granulosa cells which line the follicle They develop a yellow colour and start to secrete small amounts of progesterone The intrafollicular tension rises and degenerative changes occur in the stigma because of its greatly reduced blood supply The follicle then ruptures at this point The cumulus becomes detached from the remainder of the granulosa cells and floats out of the follicle with its contained ovum Just before this the first maturation division of the egg has taken place the second one may also occur at this time but apparently it is more commonly delayed for a few hours until the time of fertilization

The corpus luteum develops rapidly The stage of maturity is reached by about the eighth post ovulational day degenerative changes set in

causes the follicle to secrete a second ovarian hormone, progesterone At the same time when the appropriate proportions of F S H and L H are attained, and the follicle has ripened fully, it ruptures liberating its contained ovum (ovulation)

The cycle of events does not end with ovulation on the contrary this is the signal for a series of further changes of great importance within the ovary The ruptured follicle, immediately after ovulation collapses and fills with blood clot Follicle cells rapidly multiply so as to fill up the follicular cavity and to form the yellow body (corpus luteum) This continues to enlarge and to secrete progesterone for 10 or 12 days after ovulation Animal experiments give reason to suppose that a third pituitary hormone (luteotrophic hormone or prolactin) is necessary in order that progesterone secretion from the corpus luteum may occur since although L H may cause luteinization in animals from whom the pituitary gland has been removed luteotrophic hormone must be given as well if the corpus luteum is to secrete progesterone If the ovum is not fertilized pituitary activity wanes the corpus luteum regresses and the secretion of progesterone ceases Along with this the secretion of oestrogen falls too As a result the endometrium which has been undergoing development under the influence of the ovarian hormones is now deprived of its hormonal support and in consequence breaks down with accompanying bleeding This is the normal menstrual bleeding resulting from an ovular cycle since it takes place from an endometrium which has responded both to oestrogen and to progesterone When this stage has been reached the girl has attained to fertility

In normal circumstances except for interruptions due to pregnancy ovular cycles once established will continue for many years Quite commonly, however an occasional anovular cycle may be interspersed and to this no special significance is to be attributed As the conclusion of the reproductive period is approached the number of available follicles becomes less and the frequency of anovular cycles increases At this stage the regularity of the periods usually suffers too This is the climacteric or phase of waning ovarian activity Eventually when no more follicles exist the ovary becomes completely refractory to stimulation by the pituitary hormones its output of oestrogen is insufficient to build up the endometrium to a degree from which bleeding will take place and all periods cease This is the menopause

We must now consider some of these aspects of menstrual function in more detail

phase of corpus luteum activity As the corpus luteum degenerates the oestrogen level falls reaching its lowest values at the onset of menstruation which is also the start of the next cycle Progesterone production probably begins just before ovulation it increases to a maximum about eight days after ovulation and by two days later has begun to fall disappearing within two or three days of the onset of menstruation The actual detection of progesterone in body fluids is exceedingly difficult technically, but its elaboration can be followed more easily by estimating pregnanediol an excretory product which appears in the urine Studies of this substance have shown that it is produced only in ovular cycles being absent in anovular cycles

### THE FEMALE HORMONES

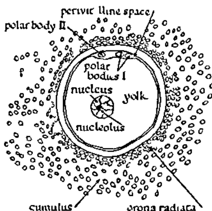
The ovary secretes oestrogens progesterone and apparently, substances with a male hormone like action or androgens All these substances belong to the chemical class known as steroids

There are three principal oestrogens found in humans They are called oestradiol (thought to be the true female hormone) oestrone and oestriol chemically they resemble one another very closely the latter two probably arising through the actions of the cells of various organs of the body on oestradiol Many other naturally occurring oestrogens are known and in addition there are several groups of entirely synthetic compounds having little chemical resemblance to the natural oestrogens but nevertheless possessing potent oestrogenic properties

The influences of the oestrogenic hormones can be divided into *genital* and *extragenital* The organs of the genital tract are the primary target for oestrogens During adolescence their action results in enlargement and differentiation of the vulva and vagina with proliferation of the epithelial cells of the latter Indeed the vaginal epithelium is so sensitive to oestrogens that Allen and Doisy [*4*] in 1923 used it as the first reliable test for oestrogenic substances (They based their test on the description, given five years earlier by Stockard and Papanicolaou [97] of the vaginal epithelial cell changes during the oestrous cycle of rodents ) It has remained the standard reaction for the purpose and is of considerable clinical value for assessing roughly the oestrogenic status of women with menstrual disorders

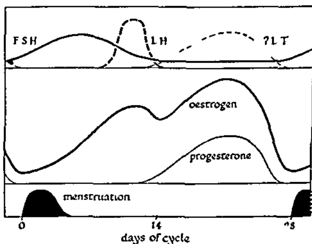
The reaction of the vagina becomes markedly acid under the influence of oestrogens the *p*H of the normal healthy vagina being about

about two days later so that by about the eleventh or twelfth day after *ovulation, little secretory activity is retained*




A newly produced egg cell

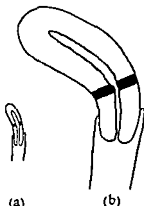
*Corresponding with these changes in its structure the ovary shows* cyclic secretory activity During the phase of follicular growth oestrogen is secreted in increasing amounts Measurements of the oestrogen




Changes in hormone levels during the menstrual cycle (L T is luteotrophic hormone)

output in women indicate that a slight fall occurs at the time of ovulation to be succeeded by a rise to a still higher level during the

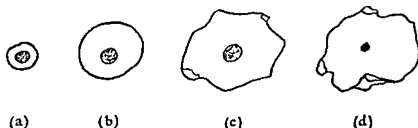
influence of progesterone during the second half of the menstrual cycle are described on page 44 It modifies the secretions of the glands of the cervix It promotes growth of the milk secreting tissue of the breasts It enhances the water and sodium retaining effects of oestrogens this is believed to be responsible for the premenstrual tension of which some women complain in the week or ten days preceding the onset of the period It appears to be of paramount importance during pregnancy, though its precise functions then are not altogether clear In some circumstances (mainly experimental) an antagonism between oestrogen and progesterone seems to exist




Proportions of uterus and cervix in infancy (a) and adulthood (b) The black band represents the isthmus the junction between cervix and body of the uterus

Just as the precise function of the oestrogens found in men is uncertain so is that of the male hormones (androgens) found in women Opinions vary greatly At one extreme are those of Hamblen [42] who states No physiological genital role of androgens in the female has been described and none seems likely In view of the defeminizing or contra sexual alterations which androgen therapy produces in woman it seems likely that gynecic functions occur despite woman s androgen moiety rather than by virtue of it At the other extreme one may quote Loeser [62] who states The androgens are as important in the economy of the female as are the oestrogens Perhaps their true significance lies somewhere in between

4 0–4 5 Growth of the cervix uterine muscle (myometrium) and endo metrium, and uterine tubes is brought about by oestrogens, and the infantile proportions between cervix and the body of the uterus are changed to those of the adult The changes in the endometrium effected by oestrogens are those found during the proliferative phase of the menstrual cycle Oestrogens exert indirect effects on the ovary, by modifying the secretion of gonadotrophins by the anterior lobe of the pituitary in excess, they inhibit the latter and so lead to depression of ovarian function, but in moderate amounts they may enhance pituitary activity and probably favour the secretion of luteinizing hormone, which stops further follicle development but leads to corpus luteum formation On the breasts oestrogens exert a growth promoting activity and cause proliferation of the duct system

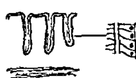



The principal types of epithelial cell found in vaginal smears (a) basal (b) primitive (c) late intermediate (d) fully cornified with pyknotic (small and densely staining) nucleus

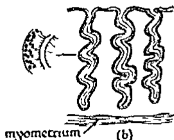
Among the extragenital effects of oestrogens are a tendency to dilatation of the blood vessels, increased growth of bone with deposition of calcium in the bone matrix and closure of the growing points (epiphyses) *retention of fluid within the tissue—particularly the skin* and subcutaneous tissues (the sexual skin of certain monkeys shows marked cyclic swelling due to the action of ovarian oestrogens and this is brought about entirely by fluid retention) retention of certain elec trolytes particularly sodium and a tendency to store nitrogen in the form of new tissue protein—but to a much smaller degree than is shown by androgens

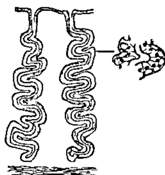
Progesterone modifies the metabolism of oestrogens and perhaps exerts its actions mainly in this way It has little or no effect on the endometrium for example, unless this is already under the influence of oestrogens and there are clear-cut synergistic effects between the two hormones *The changes in the endometrium occurring under the*

changes and so remains intact it is thus able to provide for the regeneration of the endometrium during the succeeding cycle The thickness of the endometrium becomes reduced because of collapse of the glands and resorption of intercellular fluid Now the small arteries relax

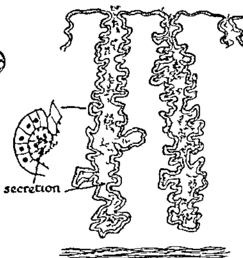


(a)



(c)




Endometrial glands roughly to scale at different stages of the menstrual cycle with insets showing microscopic appearance of the cells

(a) At the end of menstruation about the 6th day the glands are simple straight tubes

(b) Mid proliferative about the 10th day The glands are coiling (because they are lengthening faster than the surrounding stroma) the nuclei are piling up appearing to be in several layers

(c) Early secretory about the 16th day Coiling has progressed and basal vacuoles are present in the cells

(d) Mid secretory about the 24th day The glands are saw-edged because of the extensive proliferation of the endothelium Secretion is present in the lumen

### THE UTERINE CYCLE

Corresponding with the rhythmic activity of the ovaries, and brought about by the action of the ovarian hormones are the phases of growth and regression which occur in the endometrium the lining of the uterus These are described in some detail in the Appendix and will merely be summarized here At the end of menstruation the endometrium is about 1 mm in thickness The increasing amounts of oestrogen in the blood cause proliferation of the glands which grow upwards from the basal layer and restore the damaged epithelium In the typical 28 day cycle this proliferative phase lasts for 13 or 14 days and after ovulation has occurred is succeeded by the secretory or progestational phase during which the additional stimulus of progesterone secreted by the corpus luteum produces further growth and differentiation of the endometrial glands In some women a small amount of bleeding from the endometrium occurs just about the time of ovulation this is oestrogenic bleeding and corresponds with the bleeding which occurs at the time of oestrus (or heat) in some animals such as the bitch It is of no pathological significance, though from the point of view of comparative physiology it is of considerable interest it helps us to relate the menstrual cycle (which is found only in monkeys apes and humans) with the oestrous cycle of other mammals (There had been much confusion on this point until comparatively recent years ) Occasionally the mid menstrual bleeding may be so great as to simulate a period which then seems to occur once a fortnight This may lead to infertility simply by preventing sexual intercourse at the time of ovulation

The mid secretory phase is reached about the twenty fourth day of the cycle The endometrium has now been prepared to receive a fertilized ovum which if present will have reached the cavity of the uterus by this time If implantation takes place pregnancy thus begins but we will leave discussion of the subsequent events until the next chapter If implantation does not take place the waning activity of the corpus luteum results in falling levels of oestrogen and progesterone *and in consequence regressive changes in the endometrium begin* The first of these changes appears to be a marked reduction in the blood supply to the endometrium due to constriction of the small arteries The capillaries beyond these inadequately supplied with blood become damaged as do the surrounding tissues The basal layer of the endometrium having a separate blood supply does not share in these

lead to severe anaemia which curiously enough itself tends to increase the menstrual flow, thus creating a vicious circle

## CYCLIC CHANGES IN OTHER SYSTEMS

Characteristic cyclic changes have been described for the glands of the cervical canal (though recent work has cast doubt on their existence) [*16 104*] the epithelium of the vagina and the uterine tubes The secretions of the cervix have been the subject of several recent studies and are known to undergo striking and important changes in association with ovarian activity Early in the cycle the cervical mucus is scanty tacky and cellular It increases in amount, becomes more fluid and less tacky, and the leucocytes previously present gradually disappear During the two or three days immediately prior to ovulation, the healthy cervix pours forth a copious flow of clear, almost watery mucus which flows out over the vaginal surface of the cervix It is highly receptive to spermatozoa which penetrate it readily and survive within it, maintaining vigorous activity for many hours At this time it possesses in marked degree the rheological property variously called spinnbarkeit fibrosity' or perhaps better ductility that is the ability to be drawn out into a fine thread (or to be blown up into a sizeable bubble) Within a very short time (probably a few hours) of ovulation and presumably under the influence of progesterone dramatic changes occur in the properties of the cervical mucus Ductility rapidly decreases tackiness increases and leucocytes appear in large numbers Spermatozoa have difficulty in penetrating the mucus or if they succeed in doing so soon become immobilized These changes become more marked as the secretory phase proceeds and the quantity of mucus usually decreases as the next period approaches The physiological significance of these changes needs little comment they favour the reception of spermatozoa at the time of ovulation and discourage or prevent the penetration of spermatozoa at all other times

The cyclic changes in the vaginal epithelium are not very clear-cut and though some authors have advocated the use of vaginal smears in studying the menstrual cycles of women complaining of infertility with the object of determining the time of ovulation the concensus of opinion is that the findings are too variable and too indefinite for the method to be a practical one

Cyclic changes in the epithelium of the uterine tubes corresponding in a general way with those in that of the endometrium have been

again the pressure in the damaged capillaries is restored, their walls give way and blood is lost into the tissues It breaks through the surface of the endometrium and together with fragments of devitalized tissue, escapes into the cavity of the uterus This blood clots and subsequently liquefies and the liquid rather altered, blood passes through the cervical canal into the vagina as the menstrual flow *It is for this reason that menstrual blood does not clot—because it has already clotted*

If the rate of flow of blood from the endometrium is high the uterine contents may increase too rapidly for the clotted blood to remain long enough to liquefy before passing into the vagina In such a case the uterus may expel the clots into the vagina, sometimes with painful contractions and nearly always to the alarm of the woman so affected It will be appreciated however that the passage of clots has no sinister significance and is merely a reflection of the rate of flow of blood from the endometrium.

It is usual after the rupture of the walls of the capillaries, for a second phase of arteriolar constriction to occur whereby the blood flow to the bleeding areas becomes reduced Groups of arterioles relax and contract at irregular intervals so that oozing of blood occurs now here now there It seems probable that abnormalities of this vascular activity may account for the occurrence in some women of periods which though regular are unusually heavy and long it is easy to see how excessive blood loss may be the result of failure of the arterioles to constrict after the phase of arteriolar dilatation

Within a few days of the onset of menstruation, the rising levels of ovarian oestrogens result in the proliferation of the glands in the basal zone (which it will be remembered has been spared the destruction of the more superficial layers) This helps to restore the endometrium and so to seal up the blood vessels when this process is completed bleeding ceases and the new menstrual cycle is now well on its way

It is to be hoped that the foregoing description of the events of the endometrial cycle and of the way in which menstruation occurs will itself suggest the true significance of menstruation—that it is in fact the response of a disappointed womb and the dismantling of a structure which in the absence of a fertilized ovum has no further function Normal women of course with an adequate diet are able to replace the blood lost during their periods without difficulty and so do not become anaemic Excessive menstrual bleeding however, may

towards counteracting this tendency may achieve highly gratifying results

Among the subjective phenomena of the menstrual cycle two more call for consideration The first of these is abdominal pain, sometimes fleeting sometimes more prolonged experienced by some women in regularly recurring fashion at about the mid-cycle and hence called by the Germans the mittelschmerz A fascinating account of the accurately observed occurrence of this pain in one patient during the course of many cycles and its cessation during pregnancy only to return a fortnight before the first period after delivery has been given by Krohn [57] There seems to be no doubt that the mittelschmerz is in some way related to the occurrence of ovulation and is probably a pain referred from the ovary itself (or its covering peritoneum) This is made still more probable by the fact that in some women who experience it the pain occurs more or less alternately on one or other side during successive cycles suggesting ovulation first from one and then from the other ovary

The other subjective sensation is pain accompanying the period or dysmenorrhoea This is commoner and more distressing (though physiologically far less interesting!) than the mittelschmerz. It takes a variety of forms, in some women beginning before the period and ceasing soon after the flow has begun in others lasting during the first few hours or day of the flow and in yet others accompanying the whole of the bleeding It may be a mild discomfort of little consequence or at the other extreme completely prostrating It may take the form of a dull abdominal ache or violent cramping pains accompanied by nausea and vomiting Rarely it can be ascribed to the existence of serious disease within the pelvis sometimes to uterine cramps accompanying the passage of large clots during heavy bleeding but far more commonly examination reveals no evident explanation for it There is no doubt that it is commonest in introspective mentally and physically dissatisfied women and comparatively rare in those who are more fortunate in these respects It is undoubtedly related to the pain threshold of the woman this being noticeably lower in some than in others It is also more likely to be found in women with monotonous sedentary occupations than in those who have interesting jobs calling for physical as well as mental effort But apart from these psycho social aspects of the causation of dysmenorrhoea there are certain important endocrine aspects too It is widely accepted that dysmenor rhoea is rare in anovular cycles correspondingly a common history is

described It is probable, though not certain that changes in tubal activity are found at different stages of the cycle in the proliferative phase the frequency of the peristaltic waves is greater but their amplitude is less than is the case during the progestational phase But it is probable that there are many exceptions to this generalization

Microscopic and macroscopic changes in the breasts occur corresponding with the phases of the menstrual cycle Immediately before and during menstruation regressive changes occur, the epithelium in the terminal lobules actually sloughing in places Proliferation of the milk secreting cells begins about the seventh day of the cycle and continues until the onset of the next period Differentiation as well as growth of the milk ducts and glandular system occurs during this phase especially in adolescent girls Towards the latter part of the cycle there is active secretion At this time the breasts may be observed to enlarge and may feel tender They may present a finely nodular structure on palpation similar to that found in early pregnancy

Various allergic immunological and other ill understood phenomena seem to have cyclic periodicity associated with ovarian activity Migraine rheumatoid arthritis asthma myasthenia gravis urticarial eruptions and many other obscure conditions may behave in this way From the fact that these attacks sometimes cease during pregnancy (while in other cases they may be made worse by it) attempts have been made to infer a direct association with the levels of the ovarian hormones but definite conclusions can scarcely be drawn

Psychic changes occur throughout the menstrual cycle So great are the variations in different individuals that generalizations are difficult to draw Thus whereas some women lose all or most of their libido during the menstrual period others may feel more highly sexually excitable at this than at any other time Some women experience their highest libido at about mid-cycle—that is near the time of ovulation but, though this would be expected on biological grounds it is far from universal A sense of depression during the few days or week preceding the period is very common and in some women it may be so serious as to make them seek medical advice they may feel so miserable and irritable as to make married life a serious periodic problem for their husbands the more so since the traditional feminine prerogative of changing the mind may attain preposterous proportions during the premenstrual phase There is good clinical reason for supposing these unpleasant effects to be related to the sodium and water retention which occurs during this phase and medical measures directed

attempting to take vaginal temperatures—makes it a positively reckless procedure [*100*, *101*] Oral temperatures therefore would seem to be those to be chosen they are usually about 0 5° F below those obtained in the rectum, but otherwise parallel them very closely in the majority of cases

During the proliferative phase of the cycle the basal temperature runs along at a value which differs in different individuals, but averages around 97 4° F At the time of ovulation a slight or more pronounced dip sometimes occurs the temperature falling perhaps 0 4° F This ovular dip is uncommon and has little diagnostic value The temperature then climbs to a plateau which is maintained during the secretory phase the average level is then around 0 8–1 0 above that of the proliferative phase Just before or just after the onset of the period the temperature returns to the lower level only to repeat its changes during the succeeding cycle In this way a biphasic pattern is produced and is characteristic of the ovular cycle. The time relations of the post ovular plateau coincide closely with those of the activity of the corpus luteum and since it has been shown experimentally that progesterone can provoke comparable rises in the basal temperature it is generally agreed that this hormone is responsible for the plateau It will therefore be understood that in anovular cycles no such temperature rise is seen the pattern then being described as monophasic By means of basal temperature records it is often possible to demonstrate the occurrence of anovular cycles either occasionally interspersed among ovular cycles or universally even in women having apparently normal regular periods It is also possible to meet with cases where although the periods are irregular and infrequent, yet the temperature rises about a fortnight before each period remains elevated until the onset of bleeding and then returns to its previous level Where the cycles are irregular but ovular, the temperature records show that it is the pre ovular phase which varies most in duration while the post ovular phase is of far more constant length

There are of course many variants of the classical biphasic pattern and indeed the pattern varies in minor degree from cycle to cycle Often no clear-cut change from pre ovular to post ovular level can be seen since the temperature climbs gradually during several days In other cases the fall in temperature at the time of bleeding occurs slowly occupying several days in the pre ovular phase A combination of these types leads to a third rather rare variant in which the biphasic characteristic is almost lost the temperature curve merely showing a

that the periods were painless during the first year or two after the menarche—and they may also have been somewhat irregular at this time—but they became painful and more regular later on (It will be recalled that anovular cycles are more or less the rule for a year or two after puberty) Measures such as treatment with oestrogens, which suppress ovulation producing anovular cycles usually abolish the dysmenorrhoea (though they do not—necessarily—thereby cure it) Once again therefore, as in premenstrual depression we must implicate progesterone in the genesis of dysmenorrhoea in most cases—but it would be idle to suggest that we understand the mechanism involved

## CYCLIC CHANGES IN TEMPERATURE

The fact that under basal conditions (that is at rest and many hours after the last meal) the body temperature varies with the stage *of the menstrual cycle* has been known in a general way for many years It is however only during the 1940 s that the precise variations and their usefulness to the physician have been appreciated Properly recorded and properly interpreted, information of great value can be *obtained from basal body temperature records*

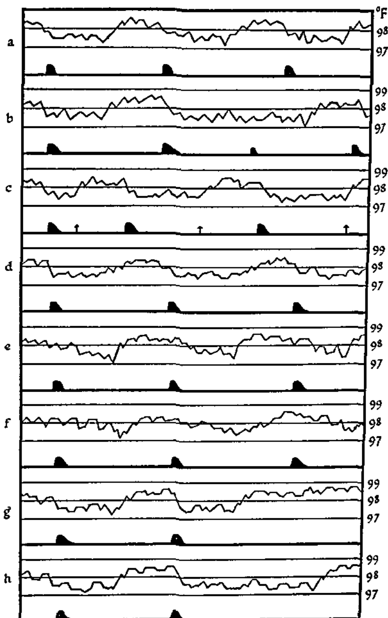
To record her basal temperatures the woman should insert the thermometer immediately on waking while still in bed, and before undertaking any form of activity *The thermometer should be left in* place for at least three minutes *by the clock* It may then be put on one side to be read when she has arisen and is fully awake (to avoid the risk of breaking it while half asleep) The reading—accurately made—is recorded against the date and the mercury in the thermometer is then fully shaken down so as to be ready for use the next day Some controversy exists on which orifice should be chosen for the insertion of *the thermometer However it is certain that in the vast majority*—provided the above instructions are correctly carried out—temperatures recorded in the mouth with the thermometer beneath the tongue and the *mouth kept closed* throughout the time of insertion yield *all the* required information There is no need therefore to advocate the rectum or the vagina as the chosen orifice The inconvenience and perhaps distaste associated with these require *no comment while the* actual danger associated with the latter—at least two cases have been reported [*34, 43*] (and the author has himself met a third—not his own) of patients passing the thermometer through the urethra and *so into the* bladder, from which operative removal was necessitated while

more or less distinct dip at about the mid-cycle It has not been possible to associate these variants with any recognizable abnormalities of the cycle

The behaviour of the basal temperature in early pregnancy is what would be expected from our knowledge of the hormonal changes in that condition The post ovular plateau is maintained and the higher level persists for several months The temperature returns slowly to the lower level towards the end of pregnancy It follows therefore that if the plateau has persisted for three weeks or more and the period is overdue pregnancy can confidently be diagnosed perhaps earlier than by any other means Temperature records also enable one to distinguish between the delayed appearance of a period due to delayed ovulation and that due to pregnancy In the former condition no temperature rise and post ovular plateau or a plateau of less than two weeks duration will be found in the latter the findings will be as already described

A final remark of practical importance must be made Although they convey much useful information and can indicate the occurrence of ovulation temperature records provide only a very approximate pointer to the actual day of ovulation and then only *after it has occurred* They do not enable one to predict when it is going to occur Unfortunately they may be misused by women who are anxious to become pregnant but failing to appreciate the above limitation attempt to time intercourse according to the changes in the basal temperature As will be seen in chapter VII it is probably necessary for intercourse to precede ovulation for fertilization to occur hence relying on the ovular rise in temperature will almost certainly make the inter course too late to be effective It seems unwise therefore for women to attempt to interpret their own temperature records and they should in general leave this task to the physician

rises slowly in the post-ovular phase in this record (e) The temperature falls slowly from the post ovular plateau (f) A combination of (d) and (e) so that little more than a mid cycle depression remains to represent the biphasic pattern (g) Here conception has occurred and the post ovular plateau persists (h) In this case delayed ovulation not conception accounts for the non appearance of the period




Basal temperature records The black shapes represent menstrual bleeding (a) The biphasic record of regular ovular cycles (b) An anovular cycle with no rise of temperature (monophasic) and a relatively scanty period between two ovular cycles (c) Irregular ovular cycles the intervals from the start of the periods to the arrows marking the occurrence of ovulation are inconstant but the post-ovular intervals are of more uniform duration (d) The temperature

Other, much rarer forms of precocious puberty may result from granulosa cell tumours of the ovary or from overgrowth (hyperplasia) or cancer of the adrenal cortex In the former the tumour could be felt in the child s abdomen by the time the symptoms are noticed When the adrenal is involved sexual development with masculinization but usually without menstruation are the distinguishing features

### AMENORRHOEA

Unduly late occurrence of the menarche may like constitutional precocious puberty, be no more than a reflexion of the normal distribution of the age of the menarche Various factors however including state of nutrition and genetic make up are believed to play a part in hastening or delaying the occurrence of the menarche Chronic illnesses such as tuberculosis may result in delayed puberty as well as delayed development generally When the menarche does not occur at all the condition is called primary amenorrhoea Two main forms can be distinguished The first is due to congenital maldevelopment or complete absence of the ovaries in such cases stature is usually considerably reduced though not to the extent of severe dwarfism and a variety of other congenital abnormalities may be found The condition is called Turner s syndrome and is characterized by the finding of an excessive output of gonadotrophin in the urine due to the absence of the inhibiting action of the ovarian oestrogens on the pituitary gland In the second main variety of primary amenorrhoea the fault appears to lie in a failure of production of gonadotrophin by the pituitary so that the ovaries themselves normal are not stimulated to produce oestrogens Girls with this form of primary amenorrhoea may either be short in stature if there is in addition a lack of growth hormone production by the pituitary gland or tall if the growth hormone production is normal because in the absence of oestrogens the growing points (epiphyses) of the long bones do not fuse at the normal time and so these bones become disproportionately long

A common menstrual irregularity is cessation of the periods after they have become established There are many possible causes for this secondary amenorrhoea pregnancy, of course causes physiological amenorrhoea various diseases such as tuberculosis major affections of the pituitary adrenals or ovaries severe malnutrition (hence the terms famine amenorrhoea and kriegsamenorrhoe —war amenorrhoea) and so on The commonest cause of secondary amenorrhoea is

V

# DISORDERS OF MENSTRUATION AND THE CLIMACTERIC

We have already considered a few departures from the normal pattern of menstruation various other common menstrual disorders must now be discussed Any attempt to describe disorders of menstruation presupposes a *comprehension of the normal*—and this is not too easy Almost every characteristic of the menstrual *cycle—the ages at which the first and last periods occur, the duration* of bleeding the amount of blood loss the interval between periods and its regularity or irregularity the extent of the subjective sensations and so on—shows very wide variation in women who may reasonably be regarded as physiologically normal Unless therefore the departure in any given case from the modal menstrual pattern is so great as to interfere with the woman s well being or reproductive ability that *departure should not be regarded as significant*

## THE AGE OF THE MENARCHE

This shows variations which typify the situation *with regard to other* aspects of the menstrual cycle This age like many biological phe nomena has approximately a normal distribution falling within the range 10–14 years for the majority of girls but spreading upwards and downwards from this range Just where normality ends and abnor mality begins is very difficult to judge When menstruation begins at a very early age it seems that a normal physiological process has *commenced unusually early if this be called abnormal then it is so* only because it is unusual Individuals displaying such constitutional *precocious puberty the term applied by Novak [75] may show no* important differences from those in whom puberty occurs at a more usual age Because ovulation may take place the possibility of preg nancy exists—and indeed it has been known to occur even at the age of 5 years [28]

energetic measures—an internal examination under a general anaes thetic, for example—before she can be persuaded that she is not pregnant Once this has been achieved and any necessary dietary measures taken the return of menstruation usually follows but not always for in some victims of this strange disorder the normal menstrual rhythm is never again achieved This condition therefore illustrates how potent can be the effect of emotional factors on menstruation

When the periods occur only at infrequent intervals they may other wise be quite normal and preceded by ovulation They then indicate merely an unusually long preovular phase and if responsible for in fertility bring about this result only by reducing the frequency of ovulation and hence the opportunities for conception They also make the approximate prediction of ovulation so difficult as seriously to reduce the chances of planning coitus to coincide with that event When however, the menstrual flow is unusually scanty as well as infrequent, the cycles are usually anovular and a more fundamental disturbance akin to that of secondary amenorrhoea then exists Therapeutic attempts to establish more regular and ovular cycles do not often meet with lasting success

### ABNORMAL MENSTRUATION

Unduly heavy periods may be regular and the flow may be of normal or prolonged duration or they may be wholly irregular both in dura tion and intensity If regular they are usually associated with ovular cycles, and very often no abnormality of the endometrium can be dis covered It then seems reasonable to predicate an abnormality of the endometrial blood vessels as the most likely cause Other possible causes are uterine disease (such as fibroids polyps or chronic inflamma tion of the endometrium) blood diseases (such as anaemia which tends to set up a vicious circle being made worse by the excessive menstrual bleeding) and emotional factors which are being recognized more and more as important

Irregular bleeding consisting of variable blood loss occurring be tween regular cyclic losses (intermenstrual bleeding) is most commonly associated with organic disease such as fibroids malignant tumours of the uterus or cervix or simple erosion of the cervix (which is often responsible for bleeding after intercourse) It always deserves gynaeco logical examination even though usually the condition is not a serious

undoubtedly emotional either some sudden emotional shock (which may not even be remembered by the patient some months later) or some major change in mode of life Thus secondary amenorrhoea frequently occurs when a girl leaves home to go to boarding school and was extremely common during the late war for girls joining the armed forces

Spontaneous resumption of the periods occurs in most cases of secondary amenorrhoea when there is no underlying disease If however, the amenorrhoea extends over a period of more than a year a less hopeful prognosis can be given for sometimes menstruation is then never resumed It is probable that the amenorrhoea is often perpetuated by the very distress which the absence of periods causes many women—because of their ignorance of the true significance of the periods and of the old wives tales with which very likely they have *been assailed If they wish to have children either in the immediate or* distant future then there is every reason to take steps to attempt the salvage of menstrual function but if this desire is not present it cannot be overemphasized that provided underlying disease can be ruled out as the cause not the slightest harm can come from the absence of periodic bleeding and the woman will be no whit the worse even if she never has another period

One other form of secondary amenorrhoea requires comment this occurs in the woman who is desperately anxious to have a baby or who on the other hand usually being unmarried is terrified by the possibility of becoming pregnant This intense desire or fear disturbs the menstrual rhythm It seems probable that emotional factors act by way of the cerebral cortex which influences the hypothalamus and this in turn affects the cyclic output of pituitary gonadotrophins The failure of a period to appear at the expected time arouses the hope *(or fear) of pregnancy and in this way a vicious circle is established* Often the same factors affect the appetite regulating mechanism (in which the hypothalamus and the cerebral cortex both play parts) the woman without perhaps realizing it eats more than before and so begins to gain weight Because swelling of the abdomen is expected in pregnancy such swelling is sought—and easily found! It is produced by an unconscious protrusion of the abdomen brought about by relaxing the muscles of the abdominal wall and contracting the diaphragm often it is aided by an unduly large accumulation of intestinal gas and perhaps faeces Thus is established the phantom pregnancy It may exert such a grip on the patient s mind as to require the most

by ovulation accounting for perhaps one in a thousand and by the degenerative process called atresia which accounts for the remainder Loss of egg-cells by atresia begins at least as early as birth and is indeed most active before puberty for the ovary of the new born has many thousands more primary follicles than that of the adolescent girl During the proliferative phase of each menstrual cycle several follicles commence to grow but only one reaches the stage of ovulation the remainder outstripped by the chosen' follicle regress and become atretic In this way during each cycle some 30 or 40 or more follicles are lost by atresia for each one by ovulation

The age at which the climacteric sets in varies in different women in much the same way as does that at which the menarche occurs it is in fact normally distributed Various factors—genetic constitution general health social influences and so on no doubt help to determine it and diseases of various sorts directly affecting ovarian physiology can accelerate it

Many have supposed there to be a relationship between the age of the menarche and that of the menopause it has been suggested that the earlier the occurrence of the former the later is that of the latter This is probably not true in an investigation of the menopause of one thousand women [*58*] it was found that the average age at the meno pause for women whose menarche occurred at 13 years was 47 3 years while that for women whose menarche occurred at 18 years was 47 5 years Occasionally the menopause occurs at a very early age—even before 20 years in these cases there is nearly always an under lying endocrine abnormality There have also been reports of the con tinuation of menstruation until very advanced years—up to the age of 104 in one instance [*76*] In general however prolongation of the menopause after the age of 55 calls for gynaecological examination to exclude the possibility of some malignant tumour of the genital tract There is good reason to suppose that many of the patients with delayed menopause reported in the older literature had oestrogen producing tumours of the ovary It is equally important or even more so to call for a gynaecological examination if after the menopause has definitely occurred, genital bleeding should reappear by far the commonest cause for this is cancer of the cervix or body of the uterus

When the number of ovarian follicles becomes significantly reduced although more or less regular cyclic activity may continue for some time ovulation does not occur in every cycle Later, ovulation ceases altogether, and by this time some irregularity of the cycles has usually

one Some women experience a more or less regular loss of blood at the time of ovulation, as already described

Wholly irregular bleeding with complete loss of the cycle is a well recognized clinical entity A typical history is as follows A woman who has previously had regular periods experiences a bout of amenorrhoea lasting for 6–8 weeks This is followed by scanty bleeding for a few days Two or three weeks later another, heavier period occurs and shortly after this a prolonged period, variable in intensity but sometimes very heavy begins and may continue for weeks or even months Repeated episodes of this kind may occur, until some effective form of treatment brings them to an end Sometimes surgical removal of the uterus (hysterectomy) is the only means of curing the distressing condition Examination of a fragment of endometrium obtained during a bleeding episode may show either an apparently normal proliferative picture an atrophic one or an abnormal type of overgrowth In the latter the thickness of the endometrium is greatly increased and the glands show large cystic dilatations This is a picture which is known to follow prolonged stimulation with relatively high doses of oestrogens The underlying pathology, therefore of this kind of irregular bleeding (metropathia haemorrhagica) is a loss of cyclic function of the ovaries, which then appear to produce a more or less constant oestrogen level if this is low the endometrium remains atrophic but may bleed just the same if it is moderate a normal proliferative pattern is found and if it is high the abnormal condition (cystic glandular hyperplasia) is produced

### THE END OF THE REPRODUCTIVE PERIOD

As described briefly in chapter I, the reproductive period in women is commonly much shorter than the total life span The main reason for this is the continual loss or degeneration of potential ova and the absence of any provision for their replacement When no more ova remain reproductive ability obviously ceases Endocrine activity of the ovary does not end in this abrupt manner and so there is a phase of waning function This phase begins before the periods cease and continues for some time afterwards The whole phase is properly called the climacteric but the term is sometimes confined to the interval between the beginning of ovarian failure and the menopause or cessation of the periods

It has already been mentioned that the ova are used up in two ways—

oestrogen level and increased output of thyroid and adrenal hormones which is responsible for most of the untoward effects which may be experienced by women at this stage The increased activity of the adrenal cortex however tends to restore the endocrine balance by taking over some of the functions of the ovary Thus there is little doubt that most of the oestrogen which circulates in post menopausal women when the ovaries have become quite functionless is secreted by the adrenal cortex This oestrogen and the other adrenal cortical hormones produced in increased amounts serve to depress the excessive pituitary activity and so reduce the thyroid overactivity The tendency to develop a considerable growth of hair on the face seen in some women after the menopause is directly due to the increased output of androgens by the hyperactive adrenal

### CLIMACTERIC SYMPTOMS

The precise frequency with which climacteric symptoms of more than minor degree are experienced is uncertain Hamblen [*42*] quotes one authority who estimated 75 per cent of all women as suffering from distressing symptoms at the climacteric and other authorities who held that 70–90 per cent of climacteric women experience no symptoms materially interfering with general health or with domestic and social activities

The symptoms of the climacteric syndrome consist mainly of psycho logical disturbances and instability in the control of the blood vessels There is no doubt that the former element is the more important for it is just those women who have or who through force of circum stances develop psychological inadequacy who are most liable to suffer from climacteric symptoms and who do so most severely Two classes of women provide the majority of recruits to the army of climacteric sufferers At one end of the social scale is the woman of wealth and social standing for whom the menopause is a reminder which cannot be ignored of advancing years with their attendant loss of good looks sex appeal and consequently dominance in her social circle At the other end is the woman who has led a frustrated existence deprived of good looks and the activities open to the more fortunate who has been unwanted and unloved for her the expectation and realization of the approaching end of reproductive function mean the abandonment of all hope of fulfilling her natural child bearing destiny It is not surprising therefore that she should show evidence of despair

become apparent Anovular cycles may continue for some time the bleeding becoming more infrequent and scantier eventually to cease altogether

The gradual lessening of ovarian endocrine activity during the climacteric leads to many secondary changes Foremost among these are regression of the genital organs—uterus vagina vulva and breasts But in many women the changes are almost imperceptibly slow and *long after the menopause little definite evidence of genital regression* may be seen The tendency to gain weight which is commonly seen at this stage of life leading to so called middle age spread has been thought to result from failing ovarian function but this is not likely A more probable explanation is that as part of the general ageing process less energy is expended but because the appetite remains unchanged a previous balance between energy intake (in the food) and that expended in the day s activities becomes converted into an excess of intake thereby leading to deposition of fat It is said that this fat has a peculiar distribution accumulating mainly around the abdomen hips and thighs But perhaps it is distributed in the same way as it would have been given a comparable weight gain in earlier years One possible explanation for the alleged special distribution is that the normal ageing process is accompanied by a *relatively greater* loss of fatty tissue cells in other parts of the body and that when new fat is layed down most appears where the fat cells remain in greatest abundance

Further secondary effects of ovarian failure are changes in the activity of other endocrine glands These are most important for a full understanding of the physiology of the climacteric Because of the progressive failure of ovarian response to pituitary gonadotrophic stimulation the modifying action of the ovarian hormones on the activity of the pituitary becomes less and less With the reduced inhibitory effect of oestrogen the production of pituitary gonadotrophin (mostly of follicle stimulating type) increases so that in post menopausal women a great excess can be detected in the urine Sometimes *this gives rise to false pregnancy diagnosis tests* thus confusing an already delicate issue if the woman fears (or hopes) that the delayed period caused by the climacteric is due to pregnancy Along with this increase in pituitary gonadotrophin production there is also an increase in the output of thyrotrophic and adrenocorticotrophic hormones These find responsive target organs and so hyperactivity of the thyroid and adrenal cortex may ensue It is probably the combination of falling

chosen implying as it does in the minds of many women, a change for the worse For the well balanced normal woman the end of menstruation need not be the end of life as she has known it to be replaced by a narrower, less satisfying existence All it should indicate is the end of the reproductive years which in any case should already have brought their own fulfilment The succeeding years can and should be no less worth living than those which have passed

or instead, a protest reaction The least susceptible women are those who have had a healthy, happy life have made a successful marriage and have raised a healthy family For them the menopause is merely another milestone in life passed with every reason to expect the next phase to be no less worth living than those which have gone before

The psychic symptoms then will be conditioned largely by the cir cumstances which have evoked them Irritability and depression are the keynote The former makes the woman short tempered and in tolerant Any slight deviation from the expected course of affairs provokes an exaggerated protest There may be associated anxiety with vague forebodings of ill health or economic disaster in the future Depression may be associated with tearfulness or with sadness in difference and apathy The woman may lose all ambition ceasing to care for her husband her home and her appearance

Changes in libido may form part of the climacteric syndrome it may increase as a compensatory reaction to waning reproductive ability or as a last fling effect or it may disappear abruptly as in the case for example of an unhappily married woman for whom the menopause can serve as an excuse for avoiding distasteful sexual activity In the well balanced woman the climacteric need cause no change in libido and many women continue to have normal and satisfying sexual relations long after menstruation has ceased

The commonest of all climacteric symptoms are the hot flushes which are a manifestation of disturbance of nervous control of the blood vessels They may be very occasional and momentary thereby causing no distress or at the other extreme exceedingly frequent and persistent creating great discomfort Treatment with small doses of oestrogens is usually remarkably effective in bringing this particular aspect of the climacteric syndrome under control but conspicuous failure is sometimes encountered in such cases the psychological element predominates and psychotherapy provides the only satis factory approach to a solution of the problem

Many other symptoms—headaches joint pains constipation urinary disturbances and so on—may occur as part of the syndrome but they are secondary to the more characteristic ones already described

A grossly misleading impression might be created if the description of the climacteric with which this chapter ends were to place an undue emphasis on its discomforts and difficulties It is not inevitable for the reproductive years of women to end in a period of misery The term change of life, commonly used to describe this stage is unhappily

the level of the future kidneys During foetal life they migrate down wards the ovaries in females remain in the pelvis, but the testes in males travel still further so as to pass through tunnels in the anterior abdominal wall (the inguinal canals) and thus reach the scrotum where they are normally found at birth When such descent is not completed the testicles are said to be undescended the condition being called cryptorchidism Sometimes maldescent is present on one side only the testicle on the other side being situated in the normal position in the scrotum Sometimes cryptorchidism is followed by spontaneous de scent at or near puberty but this is unusual and not to be expected The degree of maldescent may vary from slight when the testicles are situated in the upper part of the scrotum to extreme where they re main within the abdominal cavity The commonest position is in the so-called superficial inguinal pouch that is just outside the inguinal canal and above the scrotum Sometimes although descent has occurred the testicle may have failed to reach the scrotum through having taken the wrong turning as it were such testicles are said to be ectopic

Spermatogenesis does not proceed normally unless the testicle is in the scrotum *before* puberty For that reason appropriate attempts to bring the testicle into the scrotum before the age of 12 should be made in the case of every boy having an undescended testicle It is no use waiting until puberty in the hope that descent may occur then and equally useless to interfere once puberty has occurred and descent has failed to take place Spermatogenesis never takes place in such a testis

If both testes remain in the abdomen the boy usually fails to develop normal male secondary sex characters he is in fact an eunuchoid resembling a man who had been castrated before puberty Evidently the interstitial cells of the testis secrete little or no male hormone in these conditions But if one or both testes are only partially descended for example in the inguinal canal the secondary sex characters are normal When one testis is still undescended after puberty but the other is in its normal position in the inguinal canal many surgeons advocate re moving the undescended testicle because it is much more likely to become the seat of a malignant tumour than is a normal testis

There are a few fairly common anatomical anomalies that are the result of imperfect embryological development In the male the urethra may open along the shaft of the penis instead of at the end this being called hypospadias In the female the uterus which develops by the fusion of two distinct tubes (the Mullerian ducts) may show various degrees of failure of this process thus it may have a septum dividing its

# VI

# ABNORMALITIES OF SEXUAL DEVELOPMENT

NORMAL sexual development requires the balanced activity of several different structures beginning in early embryonic life and continuing in an orderly sequence Failure of this complicated arrangement can account for various anomalies of sexual maturation some of these are rare and little more than medical curiosities but others are not uncommon and therefore of more practical importance It is difficult to devise a classification of these conditions in what follows they will be grouped mainly as embryological faults abnormalities of the time of sexual differentiation and intersexuality

## THE SEX ORGANS

The most extreme form of abnormal sexual development is absence of the gonads altogether This appears to be far commoner in girls than in boys and is usually associated with various other congenital anomalies forming what is known as Turner s syndrome In this the person is short and stocky with a wide neck which may actually be webbed and with complete failure of puberty A characteristic finding is a substantial increase in the output of pituitary gonadotrophin (F S H ) in the urine because the pituitary is not subjected to the inhibiting action of the gonadal hormones

What is thought to be a less extreme form in the male has been described [24] In this it seems the germinal epithelium of the testis *has failed to develop so that no spermatozoa are ever produced The remainder of the testis appears to be quite normal in structure* and function and no abnormalities of hormone balance are found

A common abnormality in males is maldescent of the testicles which is due to faulty embryological development The gonads in both sexes develop in the embryo high up on the posterior abdominal wall above

tribution of the age of the menarche, corresponding with constitutional precocious puberty It may be the result of various diseases in childhood, such as deficiency of thyroid function and diabetes mellitus disease or absence of the ovaries or abnormality of pituitary function (as in pituitary dwarfism) Finally there are the cases of abnormal sexual differentiation proper wherein the expected adolescent development of the body and psyche have occurred but menstrual function has not commenced The simplest cause of this is imperforate hymen In this condition the opening of the vagina is blocked and the menstrual blood is consequently retained within Another cause is the failure of normal development of the vagina already mentioned in which there is no connexion between the introitus and the uterus This leads to the menstrual blood being retained within the uterus A third cause in this group is a failure of the uterus unlike the other oestrogen sensitive tissues to respond to the normal ovarian stimulation

Sometimes the menarche and sexual differentiation take place normally but ovulation does not begin This condition of delayed sexual maturity can be recognized only by special investigations designed to detect the occurrence of ovulation (e g basal temperature records or endometrial biopsies in the pre bleeding phase) The complaints which bring such patients to the doctor are irregular periods scanty and perhaps infrequent periods prolonged and excessive bleeding or sterility

## INTERSEXUALITY

The embryonic gonad during its earliest stages has the potentiality of developing either into a testis or an ovary Normally the direction of development is determined by the presence of one or two X chromosomes as described in chapter I In various circumstances which are ill understood abnormal differention of the gonads and embryonic genital organs may occur and give rise to various degrees of intersexuality The experimental data are reviewed by Allen [3] and by Crew [22] In the most complete form each gonad is an ovotestis—part ovary and part testis—or one is an ovary and the other a testis An individual with such gonads is called a *true* or *gonadal hermaphrodite* The condition is rare only some 40 cases have been reported in the medical literature It can be diagnosed only by microscopical examination of parts of the gonads Among the outward manifestations in a male are hypospadias undescended testicles and abnormal breast development and

cavity into two parts the body may consist of two more or less distinct halves (bicornuate uterus) and these may even have separate cervical canals The vagina develops as an ingrowth from the surface which meets the uterus at the cervix sometimes this ingrowth fails to occur and the vagina is then absent though a more or less normal uterus may exist internally

### EARLY AND LATE DEVELOPMENT

Sexual precocity is considerably commoner in girls than in boys In a recent series studied by Jolly [*51*] there were 48 girls to 18 boys It was of the constitutional variety, already described, in 30 of the girls but in only 3 of the boys The youngest girl in Jolly s series developed pubic hair at 1 month of age had her first menstrual period at 3 months and, at the time of reporting was 10½ years old and quite well In 3 other girls and 3 boys damage to various parts of the brain was con sidered as the cause of the sexual precocity in all it involved the posterior part of the hypothalamus Presumably the hypothalamus is activated so as to stimulate the pituitary to produce its gonadotrophic hormones at the abnormally early age Only these cases of sexual pre cocity—constitutional or the result of brain damage—in which the pro duction of gonadotrophins by the pituitary commences abnormally early should really be called precocious puberty and only these individuals are able to reproduce at an abnormally early age

Sexual precocity due to hormone secreting tumours is rare in both sexes In Jolly s series there was only one girl with an ovarian tumour (granulosa cell tumour) two boys had corresponding testicular tumours (interstitial cell tumour) eight boys had tumour or overactivity of the adrenal glands and one girl had an adrenal tumour Some idea of the rarity of these conditions is shown by the fact that only 12 interstitial cell tumours of the testis have been reported in the world s literature In this kind of sexual precocity in boys although the penis is large and the boy s general development that of a much older person the testicles remain infantile

The remaining patients in Jolly s series with the exception of seven female pseudo hermaphrodites were mere medical curiosities and do not require our consideration The pseudo hermaphrodites will be dis cussed in the section on intersexuality

The menarche may be delayed for a variety of reasons The com monest explanation of its late occurrence is based on the normal dis

inguinal hernia has been present on one or both sides the gonad may be found within the hernial sac This, on histological examination turns out to be a testis! In other examples both testes have been abdominal in position the condition having been determined only as the result of an abdominal operation and direct observation of the structures within The testis has the typical appearance of an undescended testis as found in an otherwise normal male that is the seminiferous tubules are well developed but contain only Sertoli cells the germinal epithelium having failed to develop In some of the patients the testes situated in the groins have been painful and so have been removed surgically This has been followed by the development of climacteric symptoms and atrophy of the external genitalia and breasts It may therefore be concluded that the testes in male pseudo-hermaphrodites actually secrete oestrogens and that these are responsible for the feminine appearance of such individuals

*Changes of sex have always aroused public interest and although* there is no doubt that they can occur in some animals true changes of sex in humans do not occur nor can they be produced surgically In the case of a true hermaphrodite with separate ovary and testis surgical repair of the hypospadias and removal of the enlarged breasts and the ovary can produce an individual more closely approaching the normal male and successful surgical removal of an adrenal tumour can turn a female pseudo hermaphrodite into a more normal female but these are not true changes of sex The spontaneous changes of sex which have been described by some of the ancient authors have in fact been nothing but the spontaneous descent of the testicles in male genital hermaphrodites Cawadias [*21*] describes two such instances To such an occurrence Ambroise Pare referred in his story of Germaine Marie a girl who at the age of 15 leapt over a stream while running after her pigs and to her horror saw male genitals And Montaigne adds that a song became current in that region warning girls against jumping too high A much more precise observation comes from Raoul Blondel It was the case of a married woman whose marital life was happy although she knew that she could never have children because she had never menstruated Intercourse was possible but difficult because her vagina was small (3 cm ) and during intercourse she had erections of the clitoris (in fact a hypospadic penis) and ejaculation Libido was of distinctly female type At the age of 45 she fell from a height of 13 feet after which accident two glands descended into the labia majora and were demonstrated to be testes with epididymis and vasa deferentia

this combination should always lead one to suspect the possibility of hermaphroditism in a female there is enlargement of the clitoris In one recently described case [41] the boy aged 15 had hypospadias breast development comparable to that of a girl, and one descended testis biopsy of which showed normal spermatogenesis there was also a uterus opening into the urethra a single uterine tube and an ovary in which the presence of a fresh corpus luteum showed that ovulation *had just taken place*

Less complete forms of intersexuality are those in which the gonads are unaffected but the genitalia are abnormal these are the so called pseudo hermaphrodites or as Cawadias [21] prefers to call them genital hermaphrodites since as he says There are no false diseases only false diagnoses When in a female foetus the adrenal cortex be comes overactive either as a result of overgrowth or because of the presence of a hormone secreting tumour, the growing foetus is sub jected to an intense masculinizing influence The external genital organs develop like those of a male so that at birth the enlarged clitoris re sembles a hypospadiac penis (because the urethra opens in the normal female position) and the labia majora appear to form a scrotum divided in two The ovaries however may be quite normal and a uterus with its appendages may be present and unaffected by the adrenal androgens Such an individual is a female pseudo hermaphrodite and is not infre quently brought up as a boy through mistaken diagnosis of the sex at birth Rapid growth with marked muscular development and the early onset of puberty is the usual sequence of events If the excessive adreno cortical activity begins in infancy precocious sexual development with virilization the sex *appearing* to change to male is the result If the effect commences after puberty defeminization followed by the devel opment of male characteristics takes place

The cause of male pseudo hermaphroditism is more obscure Hypo *spadias and undescended testicles can in a sense be regarded as a mild* form of the condition Its complete form judging by the small number of cases described in the literature (some twenty or so) is apparently rare These individuals however are so *unlike* males that very likely many examples have passed unrecognized Typically such an individual looks very much like a woman, with normal female psychological out look bodily contours external genitalia and breasts though the nipples are small Axillary hair does not develop and pubic hair is either scanty or absent No menstruation occurs because there is no uterus though a vagina of moderate size is present In a number of these persons an

## VII

## CONCEPTION AND PREGNANCY

At intercourse spermatozoa are deposited at the upper end of the vagina close to the cervix. It has already been explained in chapter IV, that the secretions of the healthy vagina are strongly acid and there is little doubt that those spermatozoa which remain in the vagina for more than a short time are all killed Some protection against the vaginal acidity is offered by the buffering capacity of the seminal plasma but this cannot be very important Close to the time of ovulation the glands of the cervical canal secrete a copious flow of mucus which exudes into the vagina This mucus has an alkaline reaction and at the time in question—close to that of ovulation—it is highly receptive to spermatozoa Those sperms which are ejaculated directly against the accumulation of mucus on the surface of the cervix will therefore have an opportunity of passing easily into a favourable medium in the cervix of the uterus they can then commence their upward journey through the cervical canal There is no acceptable evidence of directional travel by the spermatozoa no evidence that is of chemical or other form of attraction whereby the sperms are directed in their journey towards the ovum Motion within the cervical mucus is as far as we know randomly distributed in all directions and apparently this randomness holds throughout the female reproductive tract.

The question has often been raised whether other mechanisms exist for ensuring the ingress of spermatozoa into the uterus A favourite one was that during the female orgasm the uterus developed a negative pressure whereby the mucus plug with its entrapped spermatozoa was sucked into the cervical canal The main objections to this view are three first, female orgasm is not necessary for conception (a point to be emphasized since some women fear that their infertility is to be ascribed to their inability to obtain orgasm) secondly the number of sperm in the cervical mucus obtained from within the cervical canal is independent of whether female orgasm has or has not occurred and

Still less complete varieties of intersexuality are those in which the reproductive functions proper to the sex of the subject are normal, but structures and psychological features of the opposite sex are present This condition is called gynandrism when it affects the male and androgynism when it affects the female When only psychological features are involved the condition is called sexual inversion this will be considered in a later chapter

### VIRILISM

The appearance in a woman of characteristics typical of the male is called virilism One cause which we have already met is overactivity of the adrenal cortex When this starts in foetal life it causes female pseudo hermaphroditism when it starts in childhood it causes sexual precocity with virilism and when it starts in the adult it produces first a defeminization and subsequently virilism Another cause is a masculinizing tumour of the ovary This is believed to be derived from remnants of the testicular elements present in the foetal gonad During the development of virilism the periods become infrequent and scanty hair grows on the face and other parts of the body the skin becomes coarser and may show acne the voice may deepen and the clitoris enlarge

Far commoner than true virilism is an exceptional development of bodily hair or hirsutism This is quite frequent in some human groups —such as Mediterranean women—and may then be called a racial characteristic However, it also occurs in occasional individuals in other groups It represents an abnormal sensitivity of the affected hair follicles to an essentially normal hair growth stimulus Women so afflicted may have entirely normal reproductive function conceive readily and undergo normal pregnancies Others on the other hand, may have greater or lesser degrees of menstrual irregularity and probably do have endocrine dysfunction of some sort such as a minor degree of overactivity of the adrenal cortex A condition which is being more clearly recognized of recent years comprises the combination of obesity hirsutism and irregular infrequent menstrual periods In some patients showing this triad of symptoms the ovaries are found on examination to be enlarged on both sides It seems that removal of a considerable part of each ovary with reconstruction of the remainder so as to restore the ovaries to their normal size goes a long way to restoring the patient to normality

and no acceptable explanation of how this could be accomplished is forthcoming Contractions of the ovarian ligaments have been thought to bring the ovary and tube into apposition at the time of ovulation while the action of the tubal cilia is considered to promote a flow of peritoneal fluid and with it the ovum into the tube From the fact that pregnancy has been known to occur in women who have lost through surgical operation a tube on one side and an ovary on the other it is obvious that ova can occasionally at least traverse the abdominal cavity and still find their way into the uterine tube and that therefore we are far from a clear understanding of the precise mechanism involved

Transportation of ova through the tubes is less difficult to understand It is possible that ciliary action helps it the great discrepancy in size between the ovum and the spermatozoa may be invoked to explain the implied effects of the cilia being in one direction for the former and in the other for the latter since it is clear that the reversed currents be lieved to facilitate spermatozoal travel in the tubes would be without influence on the comparatively bulky ovum It is probable however, that waves of contraction in the tubes are the most important agency in carrying the ovum towards the uterine cavity

### TIME RELATIONS OF FECUNDATION

Estimates of the time required for spermatozoa ejaculated close to the external os to travel up to the fimbrial ends of the tubes range from 1 to 4 hours Spermatozoa in the cervical mucus may in favourable circumstances live for several days It must not however be assumed that spermatozoa spending such a prolonged time in the cervical canal would still be capable of fertilization the balance of evidence is in fact against this possibility In the vagina itself viability is usually restricted to an hour or two Evidence for the viability of spermatozoa within the human uterus and tubes is conflicting ranging from 20 hours [*51*] to 3½ weeks [*25*] recent experimental observations [*82*] suggest that survival up to 50 hours or more is not unusual though again survival does not necessarily imply the power to fertilize It may therefore be concluded that intercourse preceding ovulation by much more than 24 hours is unlikely to result in fertilization

Direct data on the viability of the human ovum are lacking The evidence in most of the higher vertebrates and certainly in the Anthropoidea (monkeys apes and man) which have been studied experimentally is that the ovum remains capable of being fertilized for only a very

thirdly, if orgasm is assumed to result in uterine contraction (and no one appears to have suggested that it might cause uterine relaxation) such contraction would lead to the development of a *positive* intra uterine pressure—which would expel the cervical mucus into the vagina —rather than to the postulated negative one

There are nevertheless experimental observations [78] which lead to the conclusion that some spermatozoa ascend higher into the genital tract within a very short time of coitus than could be explained by the speed of their own unaided motion The most probable explanation for this (and one which seems generally to have been overlooked) is that the penis inside the vagina acts after the fashion of the plunger within a syringe During the motions of coitus it produces an alternating suction and compression on the contents of the cervical canal as it moves out wards and inwards These motions at the time of ejaculation would lead to the outward and inward flowing of the cervical mucus assist the co mingling of seminal fluid and mucus and explain the apparently rapid ascent of some spermatozoa through the mucus within the cervical canal

Sperm transport through the uterus itself seems to depend entirely upon the unaided motility of the spermatozoa Within the uterine tubes however a new factor must be taken into account This is the current in the tubal fluid set up by the action of the cilia which line the tubal walls The direction in which the cilia beat is from the outer end of the tube towards the uterus and it may therefore be supposed that the current they produce is in the opposite direction to that in which the spermatozoa must travel to reach an ovum On the other hand the foldings of the walls of the tubes and the segmentation resulting from peristaltic activity divide the lumen into a large number of temporary compartments In each of these the ciliary current will be in the wrong direction close to the walls but in the opposite—and therefore helpful—direction in the centre of the compartment By this rather complicated system therefore it is possible that the spermatozoa are assisted in their passage through the uterine tubes to the outer ampullary portion where fertilization is believed to take place

### THE PASSAGE OF THE OVUM

Just how the passage of the ovum into the uterine tube is brought about is uncertain It has been suggested that the open end of the tube actually envelops the ovary at the time of ovulation *but this is doubtful*

12 In this case therefore, ovulation would be most likely to occur on the 12th 13th or 14th day of the cycle

### HYALURONIDASE AND FERTILIZATION

The seminal fluid of many mammalian species contains an enzyme which is capable of causing the splitting up of a complex mucoid substance called hyaluronic acid This enzyme is therefore termed hyaluronidase Its presence in seminal fluid led to the belief that it might play a part in fertilization for it was found that this enzyme from various sources (hyaluronidases have also been demonstrated in some snake venoms and in the culture media in which certain bacteria are growing) could bring about the dissolution of the cumulus surrounding the freshly ovulated egg These observations led to the corollary view that the jelly like intercellular cement substance of the cumulus is composed of hyaluronic acid A considerable body of evidence accumulated supporting the theory that seminal hyaluronidase subserved this function [98] and it seemed possible to invoke this theory to explain the fact which has long puzzled biologists that although only one sperm is involved in fertilizing an egg yet vast numbers usually of the order of many millions must ordinarily be present in the seminal fluid in order that fertilization may occur The argument ran that these large numbers of spermatozoa had to be inseminated in order that a sufficient quantity of hyaluronidase might be conveyed to and liberated near the egg so as to ensure the rapid dissolution of the cumulus and thus permit the access of the spermatozoa one of which penetrated the egg and fertilized it If too few spermatozoa reached the egg the cumulus disintegrated so slowly that by the time the egg was denuded it was no longer fertilizable Too few spermatozoa in the semen therefore was considered to result in infertility not so much because no spermatozoa reached the egg but because too little hyaluronidase was liberated to enable a spermatozoon to penetrate it before it became unfertilizable

The possibility of making use of hyaluronidase to treat infertility due to oligospermia as the insufficiency of spermatozoa is called seemed a very attractive one and various experiments were carried out to investigate it [98] The results have been unconvincing On the other hand proof that spermatozoa can penetrate the cumulus surrounding rat ova and can effect fertilization even while the cumulus is intact has been obtained by Austin [7] He and Smiles [8] have published beautiful

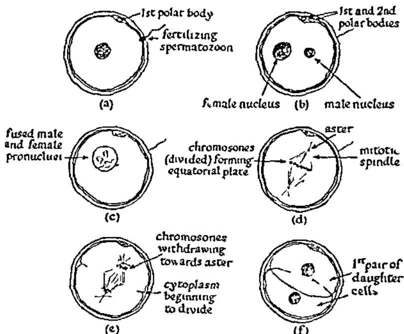
few hours probably not more than four There seems to be no reason to suppose that conditions in the human differ from this

The popular and quite erroneous, belief is that intercourse at almost any time can result in pregnancy the pregnancies following alleged rapes are cited in evidence of this The experiences, however of all who study clinically the problems of fertility in humans are overwhelmingly against such a view there cannot be the slightest doubt that the illegiti mate pregnancies mentioned above follow, as a rule repeated and not isolated coitus There are, however, a few authentic cases of conception occurring as a result either of undoubtedly isolated intercourse or of artificial insemination, on days of the menstrual cycle other than those of the mid cycle These occurrences are nearly all in women who do not have regular cycles Also relevant is the well recognized observation in women keeping basal temperature records over many months that occasionally ovulation will occur very late or very early in the cycle the subsequent period is then correspondingly late or early It is in circum stances such as these that isolated intercourse say on the 22nd or 7th day of the cycle could result in conception because ovulation happened to occur on that day Such rare occurrences—and their rarity must be emphasized—have led to the suggestion that intercourse might itself precipitate ovulation as it is known to do in the rabbit the cat and the ferret Accurate studies, however in monkeys and in humans have failed to produce any evidence in support of this view

We are therefore irresistibly led to the conclusion that conception is overwhelmingly more likely if coitus occurs at the expected time of ovulation than if it takes place at any other time In the standard 28 day cycle this time is usually the 13th or 14th day (calling the day a period begins—not finishes—day no 1) It is generally stated that where cycles are longer or shorter than 28 days subtracting 14 from the number of days in the cycle will give the most probable day of ovula tion Farris [*30 31*] however has presented evidence that this is not so according to him the post ovular phase is less constant than has usually been supposed and varies directly with the length of the cycle He believes that the best estimate of the 3 most probable days is obtained by taking the average cycle length over 3 or more successive cycles (disregarding fractions) dividing by 2 and then subtracting 2 the day so obtained and the two succeeding days are those during which ovulation is most likely to occur As an example suppose the lengths of 3 successive cycles are 26 29 and 28 days the mean length is then 28 to the nearest whole day dividing by 2 gives 14 and subtracting 2 gives

number of chromosomes that is half the number present in the nuclei of the ordinary cells of the body When the pronuclei fuse which they now do the resulting single nucleus regains the diploid or normal number of chromosomes half therefore are derived from the mother and half from the father The fertilized ovum is called a zygote

Following almost immediately upon fusion of the pronuclei the two




Fertilization In (a) the fertilizing spermatozoon is just penetrating the egg cell a single polar body is present In (b) male and female nuclei are present The second polar body has now been extruded In (c) the male and female nuclei have fused into a single nucleus Mitosis (nuclear division) is shown in (d) and (e) In (f) mitosis is complete and the first two daughter cells have been formed by division of the whole ovum

centrosomes provided by the spermatozoon separate passing to opposite poles of the nucleus thus commencing the process of mitosis The chromatin of the nucleus becomes arranged into chromosomes each of which is apparently already divided into a pair of daughter chromosomes The chromosomes appear as the equatorial plate of the spindle midway between the two centrosomes The daughter chromosomes separate from each other passing away from the equator towards the centrosomes where they lose their identity in forming the nuclei of

photographs of rat eggs, still surrounded by cumulus cells and containing male and female pronuclei—that is the nuclear elements of the fertilizing spermatozoon and of the egg It is the advent of the phase contrast microscope which had made these direct observations possible

The original theory regarding the role of seminal hyaluronidase must be abandoned It seems highly probable however that the hyaluronidase carried by each spermatozoon enables it to burrow its own way through the hyaluronic acid gel of the cumulus (the subsequent dissolution of the latter being an unimportant side effect) so as to reach the egg This being so it is quite likely that insufficient hyaluronidase might still be partially responsible for the infertility of semen of poor sperm density for it has been shown that as a suspension of spermatozoa becomes more dilute correspondingly greater amounts of hyaluronidase pass from the spermatozoa into solution Conceivably therefore spermatozoa could arrive at the cumulus with insufficient hyaluronidase to enable them to penetrate it and so reach and fertilize the egg

### FERTILIZATION

We have now arrived at the stage where spermatozoa have reached the zona pellucida of the ovum We must continue with the succeeding events the earliest of which it is to be understood have never been observed in the human Nevertheless studies on numerous other mammalian species enable us to describe with some confidence what happens at fertilization and immediately afterwards

As soon as one spermatozoon penetrates the zona pellucida a change takes place in the latter whereby the ovum becomes impenetrable to further spermatozoa Occasionally where the numbers of sperms reaching the ovum are very high more than one spermatozoon may penetrate presumably because the change in the zona takes place too slowly to prevent almost simultaneous penetration by two or more spermatozoa Polyspermy as the above rare occurrence is called may interfere with the subsequent normal development of the egg and so the arrangement which ordinarily prevents it has a biological value If the ovum has not yet undergone its second maturation division it now does so the second polar body being cast out The nucleus of the ovum becomes prominent and is called the female pronucleus at the same time the head of the fertilizing spermatozoon becomes the male pronucleus and two centrosomes all of which move towards the centre of the ovum Each of the pronuclei it will be remembered contain the haploid

will subsequently develop The wall of the blastocyst becomes differentiated into an inner cell layer and into an outer one, in which nuclear division is so active that cellular differentiation is lost These two layers form the trophoblast the importance of which will shortly appear

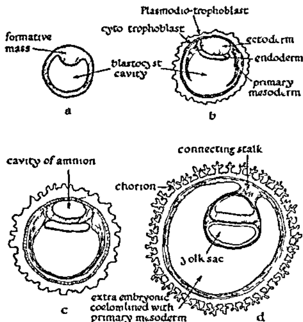
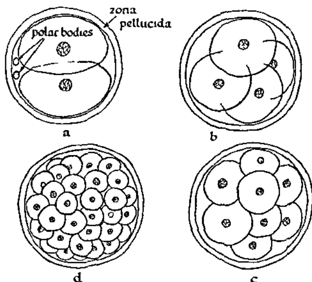



Diagram of the early development of the embryo (a) The solid morula has developed a cavity and is now a blastocyst (b) The wall of the blastocyst has differentiated into an outer layer (plasmodiotrophoblast) and an inner layer (cytotrophoblast) the formative cell mass is giving rise to the three germinal layers ectoderm mesoderm and endoderm (c) The amniotic cavity is forming within the ectoderm (d) the embryo is becoming isolated within the blastocyst cavity which is now lined with mesoderm and called the extra embryonic coelom an endoderm cavity has formed (the yolk sac) from part of which the intestines will later develop the trophoblast has now developed into the chorion (The yolk sac contains no yolk but corresponds to the structure which in our reptilian ancestors contained a large mass of yolk )

Segmentation commences during the passage of the fertilized ovum along the Fallopian tube This occupies about three days and by the time the embryo reaches the uterine cavity the zona pellucida is disappearing The formation of the blastocyst and differentiation of the trophoblast takes place in the course of the next five or six days during which the embryo lies free within the uterine cavity The embryo now

the first pair of daughter cells of the ovum These cells arise by a constriction of the cytoplasm which commences during the mitotic division of the nucleus and by its completion divides the zygote into a pair of cells, each containing a nucleus with the characteristic diploid number of chromosomes Thus is accomplished the first step in the early development of the zygote namely segmentation After a short resting period, each of the daughter cells undergoes a division precisely similar to that which produced them By repetition of this process the 4-celled zygote becomes 8 celled 16-celled, 32 celled and so on All of these



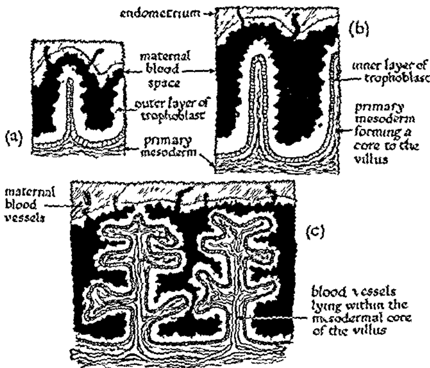

*Segmentation of the fertilized ovum (a) 2-celled stage (b) 4-celled stage (c) 8-celled stage (d) morula*

divisions reduce the proportion of cytoplasm to nucleoplasm the *daughter cells becoming progressively smaller with their nuclei remaining* approximately the same size By the time the nucleo-cytoplasmic ratio has become that of the average adult cells for the species the zona pellucida within which segmentation has hitherto been occurring disappears *and the solid mass of cells or morula as the embryo is* now called begins to increase in size

The next stage of development is for a fluid filled cavity to form within the morula which is thereby transformed into a blastocyst The cavity expands so as to occupy most of the blastocyst except for a mass of cells occupying one area the formative mass, from which the embryo

blocks of protein)—are actively pumped from maternal blood into foetal blood by cells forming part of the barrier

In the area between the embedded blastocyst and the uterine wall the trophoblastic villi become greatly expanded and complicated to form




Formation of the chorion (semi-diagrammatic) (a) shows a primary villus consisting of inner and outer layers of trophoblast and lying within the maternal blood space which it has excavated in the *endometrium* (b) is a secondary villus with a core of primary mesoderm (c) shows two tertiary villi with blood vessels lying in the mesoderm and with branching processes The last illustrates the complex and intimate relationships of maternal and embryonic tissues in the placenta

together with the altered deeper part of the endometrium the *placenta* This is a specialized organ which develops during pregnancy to provide for the nourishment of the foetus

The umbilical cord joins the embryo to the placenta It contains a pair of umbilical arteries and a single umbilical vein embedded within primary mesoderm called Wharton s jelly It also contains a structure

burrows into the lining of the uterus where it becomes embedded When this has been achieved, conception may be said to have occurred The consideration of the further changes which take place in the zygote is the province of human embryology and is beyond the scope of this book

### FOETAL MEMBRANES AND PLACENTA

In addition to the development of the embryo itself certain structures concerned with the nutrition and protection of the embryo are formed and now require a brief description

During all but the earliest stages of pregnancy, the embryo floats within the bag of waters which usually ruptures during childbirth This structure arises as a cavity the amniotic cavity, within the formative cell mass of the blastocyst It grows enormously keeping pace with the embryo which develops within it The cells lining its walls secrete a fluid, the liquor amnii The quantity of liquor increases until the 24th to 28th week of pregnancy after which it usually decreases so that at full term there is about 1 litre present (Sometimes amniotic fluid is produced in excessive quantity this condition is called hydramnios ) The amniotic fluid permits free movements of the foetus within the uterus during the later stages of pregnancy and protects it from injury it is also a minor channel of excretion for the foetus the waste products (notably urea) accumulating in it being disposed of when the membranes rupture during labour

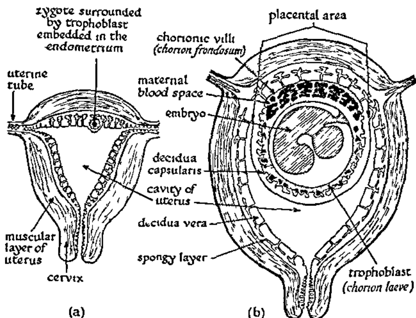
It will be remembered that the development of the blastocyst is accompanied by the formation of the trophoblast on its surface The outer layer is actively concerned in the embedding of the fertilized ovum within the endometrium It achieves this by secreting protein digesting enzymes which break down the endometrial cells In this way a loose spongework is formed in the endometrium surrounding the ovum its spaces contain maternal blood because the trophoblast digests the walls of neighbouring blood vessels The arrangement enables foetal blood contained within vessels in the mesodermal core of the chorionic villi as the strands of trophoblast are called to come into close contact with maternal blood but a barrier consisting of embryonic tissue intervenes between the maternal and embryonic blood streams Nevertheless across this barrier oxygen carbon dioxide glucose amino-acids and other nutrient and excretory materials pass comparatively freely Indeed, some substances it seems—notably amino acids (the building

The surface from which the umbilical cord arises is covered with the smooth and glistening amnion while the chorionic villi give the opposite surface a granular appearance

### UTERINE CHANGES IN PREGNANCY

The changes in the endometrium during early pregnancy adapt it to meet the needs of the growing embryo which behaves like a parasite obtaining its nutrition from its host the mother Because however, the uterus has to adapt itself to accommodate the rapidly growing embryo and at the end of pregnancy, to provide for the expulsion of the foetus profound changes in the muscle layer (the myometrium) also occur Some idea of these changes will be gained from the fact that the normal non pregnant uterus is approximately 7 5 cm (3 in) long 5 cm (2 in) wide and 2 5 cm. (1 in) thick while at the end of pregnancy it may measure 33 5 cm (13 in.) in length 25 cm (10 in) in width, and 24 cm (9½ in) in thickness Its non pregnant capacity is perhaps 7–8 c c (a quarter of an ounce) while at term it contains a foetus averaging 3 2 kilos (7¼ lb) in weight a placenta weighing 450 g (1 lb) or more and in addition 1 litre (nearly 2 pints) of amniotic fluid It must not be supposed that the uterine wall is merely stretched so as to accommodate its contents on the contrary the muscular wall *grows* so as to keep pace with the enlarging contents and to prevent any increase in the intrauterine pressure The weight of the uterus itself not including its contents increases some twenty times during the course of pregnancy This increase in uterine substance is the result of enlargement of the existing muscle fibres the growth of new fibres and the laying down of new elastic tissue The muscle fibres increase from 7 to 11 times in length and from 2 to 5 times in thickness New fibres are produced throughout pregnancy they are most plentiful in the fundus of the uterus The new elastic tissue on the other hand is layed down mostly in the lower part of the uterine body In this way there develops the *lower uterine segment* (derived from the isthmus of the uterus) which is the part of the uterine wall extending upwards from the cervix (for about 3 or 4 in at the onset of labour) It contains relatively few muscle fibres but abundant elastic tissue in contrast to the upper segment which is highly contractile During labour the lower segment helps to equalize the pressure during contractions of the upper segment it becomes gradually stretched as the upper segment retracts forcing the foetus downwards It also helps to establish and to maintain a definite

the allantoic canal which arises from the hind gut of the embryo and remains undeveloped in the human, though in reptiles birds and many mammals it expands as the allantois and plays a part in foetal respiration The cord is covered by a layer of amnion Owing to the unequal growth of the two umbilical arteries the cord becomes twisted it also increases in length, so that at term it is about 50 cm (20 in) long




Diagrammatic vertical sections of the uterus in early pregnancy In (a) the zygote has just become embedded within the progestational endometrium In (b) the embryo has grown the embryonic vesicle expanding within the endometrium so as to separate the decidua capsularis covering the vesicle from the decidua basalis which forms the maternal part of the developing placenta The foetal part of the placenta is forming from the chorion frondosum The remainder of the trophoblast which surrounds the embryonic vesicle is less well developed and forms the chorion laeve

Foetal blood is pumped along the umbilical arteries to the placenta and after passing through the placental capillaries is returned to the foetus via the umbilical vein

After the birth of the baby the placenta and attached membranes separate from the uterus and are expelled as the afterbirth The expelled placenta has a weight of about 500 g (just over 1 lb) a diameter of 15–20 cm (6–8 in) and an average thickness of about 3 cm (1¼ in)

pole remains firm because of its attachment to the vagina and to the pelvis by the various ligaments

The blood supply to the uterus from the ovarian and uterine arteries is greatly increased during pregnancy The blood vessels increase not only in calibre but also and to a far greater extent, in length so that they run a very tortuous course This arrangement prevents their being damaged during labour

The cervix becomes softened early in pregnancy, and in common with the vagina, its blood supply is increased This gives it a characteristic bluish appearance which in combination with its softness produces another diagnostic sign of early pregnancy The endocervix hypertrophies greatly and the cervical mucous plug usually becomes thick serving to prevent the entrance of bacteria into the pregnant uterus

### CHANGES IN OTHER SYSTEMS

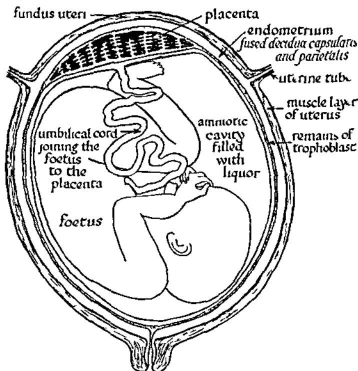
The changes in the breasts which occur during the latter half of the menstrual cycle are continued during pregnancy Tenseness and slight pain are often experienced during the early weeks and definite increase in size begins by the 8th week There is growth of the milk secreting tissue and secretion of colostrum may commence by the 10th or 12th week The nipples enlarge and become more erectile The pigmentation of the areolae increases and some of the glands of the areola become more prominent (Montgomery s tubercles) Superficial veins are usually easily seen Later because of stretching of the skin of the breasts the elastic tissue may give way producing pink irregular lines on the skin (striae)

The same kind of distension though on a greater scale accounts for the regular occurrence of striae on the skin of the abdominal wall Increase in pigmentation is also found affecting particularly those areas which are ordinarily pigmented to some extent it is believed to be due to the action of oestrogens which as will be seen are produced in large quantities during pregnancy The activity of the sweat and sebaceous glands of the skin increases during pregnancy and the hair grows faster

The skeleton undergoes some changes during pregnancy If the mother s intake of calcium is insufficient to supply the requirements of the foetus her skeleton will be depleted of the mineral In extreme cases this may lead to serious bony deformities because the demineralized skeleton softens and is then unable to withstand the pull of muscles and

presenting part—that is the part of the foetus, usually the head which is gradually forced through the cervix by the repeated contractions of the upper segment

When implantation of the fertilized ovum occurs a local increase in the blood supply to the implantation site quickly follows Enlargement




At a later stage than that shown in the previous figure the foetus suspended within the amniotic cavity has grown to such an extent as to fill the uterine cavity it now greatly expands the uterus itself The decidua capsularis and decidua parietalis are everywhere in contact and can no longer be distinguished The placenta is fully developed and connected to the foetus by the umbilical cord

of the uterus begins at this point so that at first the growing uterus is somewhat asymmetrical this asymmetrical enlargement is one of the early diagnostic signs of pregnancy As pregnancy advances the asymmetry is lost and the thickness of the uterus approaches its width From the 12th week the uterus rises out of the pelvis and becomes mainly an abdominal organ The fundus becomes more mobile though the lower

pole remains firm, because of its attachment to the vagina and to the pelvis by the various ligaments

The blood supply to the uterus from the ovarian and uterine arteries is greatly increased during pregnancy The blood vessels increase not only in calibre but also and to a far greater extent in length, so that *they run a very tortuous course This arrangement prevents their being* damaged during labour

The cervix becomes softened early in pregnancy and in common with the vagina its blood supply is increased This gives it a characteristic bluish appearance which in combination with its softness produces another diagnostic sign of early pregnancy The endocervix hypertrophies greatly and the cervical mucous plug usually becomes thick serving to prevent the entrance of bacteria into the pregnant uterus

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of gravity This condition is called osteomalacia Apart from such pathological changes, certain physiological modifications are encountered The joints of the pelvic bones enlarge and become softer thus permitting a certain amount of flexibility during labour These modifications are probably brought about by the oestrogens of pregnancy, but it is possible that another hormone relaxin thought to be produced by the ovary, is chiefly responsible Modifications in the curvature of the vertebral column and in the tilt of the pelvis occur later in pregnancy to compensate for the increasing weight of the uterus and its contents They may lead to considerable discomfort from backache because of unaccustomed strains being thrown on muscles and ligaments

There is notable storage of water and protein during pregnancy The circulating blood volume increases and a slight degree of anaemia is a common result The blood pressure falls in early pregnancy and unless complications occur later, it remains comparatively low An increased efficiency of the heart can be demonstrated and it is clear that these modifications of the circulation help to maintain an adequate blood supply for the uterus and embryo and prepare for the stresses of labour

Quite commonly the weight falls during the first few weeks of pregnancy, because the appetite is often disturbed and some nausea is usually experienced as will be discussed again later Soon however the appetite increases over and above the level required to ensure a calorie intake sufficient merely to provide for the day s energy expenditure As a result the weight increases Such an increase should not be appreciable until the 12th to 16th week and is greatest during the last twelve weeks or so of pregnancy The average weight gain by the end of pregnancy is about 9–14 kilos (20 to 30 lb ) and is undoubtedly excessive There is some reason for believing that an increase of 14 lb is quite sufficient and that the prevention of excessive weight gain (which implies certain sensible dietary measures) lessens the risk of producing overweight babies and of developing toxaemia of pregnancy this will be discussed again later

A lowering of the renal threshold for glucose that is the blood sugar level at which the kidney allows sugar to appear in the urine is typical in pregnancy Because of this sugar may appear in the urine even when the blood glucose level is within normal limits Since however some women develop true diabetes mellitus during pregnancy it is important for the blood sugar level to be checked if sugar is found in the urine This is one of the reasons why women attending ante natal clinics have their urine tested and why some may have blood sugar tests as well

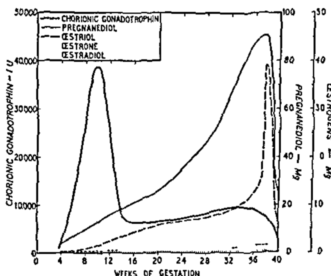
### HORMONE CHANGES IN PREGNANCY

We have already seen that implantation of the fertilized ovum is followed by profound changes in the uterus and in many other systems of the body These changes are mediated by variations in the hormone levels which we must now consider

*A new hormone characteristic of pregnancy is secreted by the tropho* blast of the fertilized ovum Because of its origin this hormone is called chorionic gonadotrophin It is a protein substance and as soon as the ovum has become embedded within the endometrium, it passes into the maternal blood stream and appears in the urine It prevents the de generation of the corpus luteum which is ordinarily responsible for the onset of menstruation in the absence of conception Whether it acts directly on the corpus luteum, promoting luteinization and the further secretion of progesterone and oestrogen or whether it stimulates the anterior lobe of the pituitary gland to secrete luteotrophic hormone which in turn maintains the functional state of the corpus luteum is uncertain *The secretion of chorionic gonadotrophin increases rapidly* reaching a peak about the 70th day of pregnancy at which stage the daily output in the urine may be about 25,000 international units From this point the secretion declines equally rapidly, so that by the 20th week the daily output has fallen to around 5 000 i u This level is there after maintained except for a slight rise during the last few weeks of pregnancy It must be confessed that we are far from understanding the true significance of these striking changes

It was mentioned that chorionic gonadotrophin is a protein deriving as it does from embryonic tissue which is at least in part foreign to the mother (the father s contribution) it seems possible that the hormone might give rise to sensitivity reactions like other foreign proteins in susceptible individuals There is in fact much evidence which indicates that the peculiar and unpleasant symptoms—particularly the nausea and vomiting—which many women experience early in pregnancy are in the nature of a hypersensitivity response to this hormone Some women observe these symptoms even before the period has become overdue at this stage chorionic gonadotrophin is the only new factor present which could be held responsible In women who have persistent and excessive vomiting during pregnancy (hyperemesis gravidarum) excep tionally large amounts of the hormone have been found Again similar severe symptoms are common in women who have hydatidiform mole a pathological change in the placenta which also gives rise to an excess of chorionic gonadotrophin

Up to about the 12th week of pregnancy the production of progesterone and of oestrogens by the corpus luteum shows a gradual increase By this time, however the corpus luteum has begun to degenerate while the placenta has become established Hormone production is now taken over by the placenta and a rapid rise in progesterone and oestrogens occurs Sometimes it seems hormone production by the corpus luteum fails before its production by the placenta has become fully established it is thought that this may account for the frequent occurrence of abortion between the 10th and 12th weeks




Average urinary excretion throughout pregnancy of the principal hormones

*R p d ed f om th B it h M d l J u l*

Our knowledge regarding progesterone production is somewhat indirect Progesterone can be extracted from the corpus luteum and from the placenta but it does not appear in the urine (except in trifling amounts) and there is considerable doubt regarding its existence in the blood [20] On the other hand *pregnanediol* a metabolic product of progesterone appears in the urine during the luteal phase of the menstrual cycle and during pregnancy It has been the subject of extensive studies and is usually considered to reflect at least in a general way the production of progesterone The curve of pregnanediol excretion during pregnancy is shown in the accompanying figure

The three oestrogens oestradiol oestrone and oestriol are all found in

the urine in increased amounts during pregnancy The daily excretion of the first two rises from a few thousandths of a milligramme before preg nancy to perhaps half a milligramme at term but the rise in the amount of oestriol is from a similar initial value to something like 20 to 40 milligrammes a day The excretion in the urine of these amounts of oestrogens indicates that their production during pregnancy goes on at a rate which is thousands of times greater than in the non pregnant state It is thought that the oestrogen actually secreted is most probably oestradiol which becomes converted into oestrone and finally to oestriol this would account for the far greater amounts of the last substance There can be no doubt that the oestrogens and progesterone are the principle agents whereby the changes of pregnancy in the uterus and breasts are brought about

### TESTS FOR PREGNANCY

In general the diagnosis of pregnancy can be made with a fair degree of confidence by about the 8th week on the history and findings on examination Before this time the findings may be suggestive but in conclusive Often however complicating factors may make the diag nosis of early pregnancy difficult or impossible The policy of wait and see usually allows doubt to become certainty but the patient may not relish the idea of remaining in a state of indecision while the course of events itself makes the diagnosis for the doctor or because the deter mination of the diagnosis may decide the proper course for the doctor to follow in the care of the patient he may wish for guidance other than that provided by the march of events In these circumstances recourse is had to pregnancy diagnosis tests

The value of basal temperature records has already been mentioned If the period is overdue by more than a week and the post ovular plateau has been maintained for more than 20 days pregnancy can confidently be diagnosed The pregnancy diagnosis tests in most exten sive use however are those which detect the presence of chorionic gonadotrophin in the urine For this purpose various animals have been utilized since Aschheim & Zondek [*6*] first used the immature female mouse in 1928 These authors showed that a series of daily injections of pregnancy urine would cause ovulation in such mice leading to the formation of haemorrhagic follicles in the ovaries Friedman [*36*] modi fied this test by showing that a single intravenous injection of the urine into a rabbit would also cause ovulation Whereas in the first of these

tests it is usual to inject each of three or more immature female mice daily for three days and to kill them on the fifth day in order to examine their ovaries, in the Friedman test a single injection in a single mature female rabbit is sufficient and the result can be obtained 24–48 hours later More recently, various amphibians have been found to respond to chorionic gonadotrophin The female South African clawed toad (*Xenopus Laevis*) will lay eggs within 24 hours of receiving an injection of pregnancy urine [12 46 90] while in the case of the South American toad (*Bufo arenarum Hensel*) injection of pregnancy urine into the male is followed within 3 hours by the passage of spermatozoa into the urine where they can easily be observed under the microscope [37] Other male amphibians show the same response the edible frog (*Rana esculenta*) the North American leopard frog (*Rana pipiens*) and though rather unreliably the common British toad (*Bufo Bufo*) have been used successfully but the common British frog (*Rana temporaria*) is not suitable for the test

# VIII

## SPECIAL PROBLEMS OF PREGNANCY

THE full discussion of the problems of pregnancy is obviously the task of a text book of obstetrics and consequently will not be attempted here Some of the commoner abnormalities how ever are of importance for giving a proper perspective to this account of human reproduction

### ABORTION

Abortion is probably the commonest abnormality of pregnancy Statistics on the frequency of abortion are difficult—or indeed im possible—to obtain the incidence of criminal abortion is uncertain but even apart from this there can be no doubt that many abortions take place so early in pregnancy that their occurrence is scarcely suspected the woman merely remarking on a slightly delayed perhaps heavier and somewhat painful period The most conservative estimates place the incidence of spontaneous abortion at about 10 per cent of all pregnancies but many authorities regard 20 per cent as by no means an unreasonable figure

With criminal abortion we need concern ourselves only briefly it raises serious social as well as moral problems and always leads to the risk of dangerous pelvic infection which often results in permanent sterility by blocking the uterine tubes

Spontaneous abortion consists of the expulsion of the products of conception occurring as a result of natural causes usually following the death of the embryo The term is sometimes reserved for this event occurring before the 16th week between the 16th and 28th weeks the term miscarriage is then applied thereafter (during the period of viability) premature labour is used but there is no essential difference between any of these events

There are many possible causes for spontaneous abortion They

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that of appendicitis) If no action is taken sooner or later the tube is pierced by the growing chorion and the patient becomes profoundly shocked from the resulting bleeding Urgent operation is required to prevent death from bleeding and to achieve this the damaged tube has to be removed

### PLACENTA PRAEVIA

The usual site of implantation of the fertilized ovum is the fundus of the uterus Occasionally however implantation is low down in the uterus and the placenta when it has developed extends either partly or wholly over the lower uterine segment This condition is called placenta praevia It may give rise to bleeding during the later weeks of pregnancy and it leads to a difficult obstetric problem when the cervix dilates during the first stage of labour extensive separation of the placenta will be followed by extremely severe haemorrhage from which death can easily result Nowadays when placenta praevia has been diagnosed most obstetricians deliver the baby at a selected time before labour begins by Caesarean section This reduces the risk of sudden uncontrollable haemorrhage

### MULTIPLE PREGNANCY

Twinning has a familial tendency and women who have given birth to twins are likely to bear twins in subsequent pregnancies they are also more likely than other women to conceive with triplets It is usually stated that twins occur once in about 80 pregnancies triplets once in 80 squared and quadruplets once in 80 cubed but twinning rates vary in different countries Twins are of two kinds when a single ovum has been fertilized but produces two distinct embryos they are said to be uniovular when two separate ova have been fertilized they are called binovular In the latter case each embryo has its own amnion chorion and placenta and such twins which may be of the same or opposite sexes bear no more resemblance to one another than do ordinary brothers and sisters For uniovular twins there is a single chorion and placenta but each twin has its own amnion such identical twins are always of the same sex and are usually as like as two peas in a pod Triplets may be uniovular binovular or triovular in the first case which is exceedingly rare a single fertilized ovum gives rise to three separate embryos which resemble one another like identical

can be classified as paternal maternal foetal and placental However, the view which is gaining most adherents at present is that foetal causes that is defects in the fertilized ovum itself are the most important at least for the early abortions (before the 12th week) The elegant studies of Hertig & Rock [*45*] on abnormal human ova recovered from uteri removed by surgical operation (the operations having been performed of course, for medical reasons) have emphasized the frequency with which abnormality of segmentation of the fertilized ovum occurs In their series of 28 early ova recovered in this way at least 7 were so obviously abnormal that, had there been no surgical interference early spontaneous abortion would inevitably have occurred and in four it would perhaps have been so early that there might have been no clinical evidence of pregnancy Yet *in all these cases the endometrium had developed properly* so that there was no evidence of maternal deficiencies to account for the abnormalities in the developing ova If this view is correct then it would seem that most early abortions represent nothing more than the satisfactory disposal of mistakes in reproductive experiments It follows that attempts on the part of doctors to prevent their going on to completion are really ill advised interference with a well ordered natural safeguard at all events these attempts usually fail

The term threatened abortion is applied when uterine bleeding occurring in pregnancy indicates some disturbance which may lead to abortion The adjective inevitable is applied when pain, due to uterine contraction and some dilatation of the cervix indicate that the process of expelling the uterine contents has already begun or when death of the foetus has occurred as shown by a negative pregnancy diagnosis test

## ECTOPIC PREGNANCY

Sometimes the fertilized ovum fails to reach the cavity of the uterus but becomes embedded elsewhere—most commonly in the Fallopian tube but occasionally in the ovary or still more rarely in the peritoneal cavity This is called ectopic pregnancy It occurs in Great Britain in about 1 in 300 pregnancies Abdominal pregnancies have been known to go to term and to deliver the baby it has been necessary to open the abdomen surgically When however the ectopic pregnancy is tubal the growing embryo stretches the tube and causes abdominal pain (which if on the right side may be very difficult to distinguish from

has almost as good a chance of conceiving as the non-diabetic but in spite of diabetic control the likelihood of losing the baby either by late intrauterine death or by early neonatal death has still remained high The infant of the diabetic mother is usually oversize, but never theless at birth is liable to have the precarious existence associated with premature infants (which of course are ordinarily undersize) Hydram nios an excess of amniotic fluid is common and the frequency of late pregnancy toxaemia is increased A striking result of the attention which these problems have received in recent years has been the realization that similar disturbances in earlier pregnancies have occurred in women who have subsequently developed diabetes There has thus come to be recognized a prediabetic state antedating the onset of clinically recognizable diabetes during which over a period of ten or fifteen years the woman may have given birth to overweight babies or have had late intrauterine death of the foetus It is clear therefore that it is not the diabetes itself which gives rise to the char acteristic effects on the foetus and it is now thought possible that a common factor may be responsible both for the deleterious action on the foetus and for the subsequent development of the diabetes One such possible factor is an over production by the anterior lobe of the pituitary gland of the growth hormone This hormone is known to have diabetogenic effects and it might be responsible for the oversize foetus

## TOXAEMIA OF PREGNANCY

A group of disorders the true nature of which remains obscure occurring at different stages of pregnancy are included under the heading toxaemia of pregnancy Opinion varies on which disorders should and which should not be included within this group and similar divergence of view is found on the question whether these disorders are entirely unrelated or are simply various manifestations of a common underlying disturbance in the metabolism of the body brought about by pregnancy Pregnancy in fact is the only feature common to them all and some certainly can occur in non pregnant persons The most important is pre eclamptic toxaemia so called because it may lead on to the condition of eclampsia in which the woman has fits

In spite of very extensive researches late pregnancy toxaemia remains largely an enigma It is the disease of theories and although facts

twins in the second and most usual case, two ova are fertilized but one gives rise to twins while the other develops as a single embryo in the third and again very rare case three separate ova are fertilized Quadruplets are nearly always formed from two fertilized ova giving rise to two pairs of identical twins

### DEATH OF AN EARLY FOETUS

Death in utero is sometimes very difficult to diagnose at first Usually the mother is aware that the pregnancy is not progressing properly and may complain of chilliness depression and a foul taste in the mouth The expected increase in the size of the uterus does not occur and the foetal heart sound cannot be heard at the expected time (the *foetal heart* becomes audible between the *18th* and *24th* week of gestation) In the same way, quickening—the foetal movements felt by the mother normally about the 18th week—does not occur There are regressive changes in the breasts Intrauterine death in advanced pregnancy is of course easily detected because foetal movements and heart beats stop Usually the dead foetus is eventually expelled naturally but sometimes it becomes necessary for the obstetrician to remove it Absorption of the amniotic fluid in a pregnancy occurring outside the uterus may be followed by the infiltration of the dead foetus by calcareous material, leading to the formation of a lithopaedion ( stone child ) which may be carried in the abdomen for an indefinite period without apparent untoward effects

The common infectious diseases may sometimes arise in pregnant women and complicate their antenatal course Sometimes they lead to abortion or premature labour German measles (rubella) though ordinarily regarded as a trifling disease is a serious affair during the first few months of pregnancy since as is now recognized it can cause foetal abnormalities

### DIABETES AND PREGNANCY

The association of diabetes mellitus and pregnancy raises some very interesting problems Before the days of insulin such a combination was so uncommon as to be a medical curiosity because the uncontrolled diabetic woman rarely succeeded in becoming pregnant The foetal mortality in these rare pregnancies was very high—about 50 or 60 per cent Nowadays with proper insulin control the diabetic woman

conditions all of which lead to the same end result an oversize baby due to an excessive intake of food by the mother or as a result of diabetes mellitus twins hydramnios a uterus which has not undergone the hypertrophic changes of a previous pregnancy or belonging to an older woman is less able to undergo the growth and expansion de manded of it by its contained foetus and inability of the blood vessels of the uterus to undergo the necessary enlargement The common effect of all these appears to be a change induced in the blood supply of the kidney leading to the production in that organ of pressor sub stances, which secreted into the circulating blood cause a rise in blood pressure because they constrict the arterioles throughout the body

The earliest recognized change in toxaemia is usually a rise in blood pressure simultaneously damage to the walls of capillaries leads to the accumulation of fluid within the tissues called oedema which usually affects first the ankles then the legs and so upwards Continuation of the disease results in damage to the kidneys so that albumin appears in the urine Raised blood pressure oedema and albuminuria are thus the principal signs of severe pre-eclamptic toxaemia and this if allowed to continue is very likely to be followed by fits If these occur the chances of losing the baby become very great and the risk to the mother herself is most serious

While it will be clear that the main risk of pre-eclamptic toxaemia is the development of eclampsia even without that final calamity the possibilities of intrauterine death of the foetus or early neonatal death are quite serious This is because degenerative changes occur in the placenta interfering with the proper nutrition of the foetus Fortu nately toxaemia need not leave any permanent residual disability nor is it true that having had toxaemia in one pregnancy a woman is bound to have it in a subsequent one though the likelihood is certainly increased

Although we are far from understanding the cause and nature of toxaemia a good deal is known about how to deal with it and how once it has appeared to prevent it from getting worse Early recognition is of vital importance in the successful treatment of toxaemia and for this to be possible proper ante natal care is essential Rest in bed is the keystone of treatment This measure alone is sufficient in many of the milder cases and it usually causes a prompt fall in the blood pressure One of the important reasons for desiring this result is that if the blood pressure rises above a certain level (180 mm Hg ) there is a grave risk of accidental haemorrhage that is partial detachment of the placenta

are far from lacking, their synthesis into a coherent and intelligible picture of the causation and true nature of the disease has not yet been achieved Because of this late pregnancy toxaemia is one of the two major unsolved problems of obstetrics the other being uterine inertia which we shall encounter in the next chapter

The name toxaemia clearly indicates that the older obstetricians had the idea of a circulating toxin as being responsible for the disease This was thought to arise from the foetus the placenta or from the ingested food as a result of changes in the metabolism brought about by pregnancy These ideas, after being largely discarded have again come in for consideration though in different forms

The Smiths [95] have elaborated a theory involving menstrual toxin a protein substance which they believe is liberated into the blood stream from the degenerating endometrium during menstruation and from the placenta in toxaemia Another theory which had considerable currency 20 or 30 years ago regarded focal sepsis that is localized infection as in a decayed tooth as responsible for toxaemia but in those days focal sepsis was blamed for most diseases of unknown cause just as psychosomatic disorders were fashionable more recently and are now only slowly being relegated to their proper position in the general medical scheme Some of the facts concerning diet in relation to toxaemia are very striking Thus the disease is practically unknown among Africans in their native countries where malnutrition is rife and it became almost non existent in European communities suffering *severe dietary restriction during the recent war* On the other hand, it is common in well nourished communities but in Great Britain, more common in the north than the south There are those who believe that excessive protein and salt intake may be the responsible factor in the influence of diet but this is far from certain

The incidence of toxaemia is higher during first pregnancies than subsequently and particularly in older women having first pregnancies It is much higher in multiple pregnancies than in normal ones Toxaemia is also common in diabetic pregnancies as has already been mentioned These facts and the results of some of the investigations on the deranged physiology found in toxaemia have led to a new conception which is gaining adherents According to this one of the main underlying causes is failure of the blood supply of the uterus to keep pace with the demands of the foetus together with a similar failure on the part of the uterine muscle to grow fast enough to keep pace with the expanding uterine contents In other words there are several

the foetus are determined By means of these frequent checks the onset of disease such as toxaemia the development of anaemia or departure from the expected sequence of uterine changes can be recognized early and appropriate measures can be instituted Many obstetric emergencies can be averted in this way For those who desire fuller information on this subject *Ante natal and Post natal Care* by Professor F J Browne is the standard work [*19*]

PSYCHOLOGICAL ASPECTS

Recent years have seen increasing attention being paid to the woman s own attitude to pregnancy Opinions are still divided on the importance of the psychological approach as an integral part of ante natal care and many so-called orthodox obstetricians belittle its significance others (e g Read [*79*]) believe that proper attention to the emotional aspects of pregnancy may make all the difference between natural and unnatural childbirth while yet others accept the potential dangers of undue emotional disturbance but hesitate to regard the psychological approach as more than a minor part of obstetrical care There can be no doubt that for many women pregnancy is a period of fearful anticipation of an event which from time immemorial has been regarded as one fraught with pain distress and danger The very name 'labour suggests effort and suffering to most people but while conscious effort is nearly always required in normal childbirth suffering is by no means invariable It is conspicuously absent in many women in primitive communities There certainly exists therefore a *prima facie* case for concluding that if fear can be banished during pregnancy and parturition the likelihood of normal labour being accomplished without suffering and with little discomfort will be increased

There is no need to elaborate here how fear can play havoc with normal bodily functions everyone knows how it makes the heart beat faster may cause sweating nausea ( sick with fear is a well known expression) diarrhoea the urge to void urine and various other manifestations of disordered physiology It requires no great stretch of the imagination to see how it can disturb the proper functioning of the uterus during its efforts to expel the foetus at term Fear may heighten the awareness of discomfort and increase the sensation of pain indeed a thoroughly frightened person will interpret quite ordinary stimuli such as touch or warmth as being painful A frightened woman therefore quickly becomes an unco-operative woman

with bleeding This bleeding may either be revealed by the blood flowing from the vagina or it may be concealed In the latter case, the occurrence of placental bleeding may not be recognized but as a result of *diminished placental function* the foetus may die in utero or alternatively a still more serious condition may result in which the blood flowing from the damaged placental blood vessels infiltrates the wall of the uterus This creates a state of profound shock which may lead to the mother s death

### ANTE NATAL CARE

One of the outstanding features of obstetrics during the present century has been the progressive reduction in abortions stillbirths and neonatal deaths and in the risks to the mother of pregnancy and childbirth Various factors have by their combined influence, brought about this admirable result and there can be no doubt that the increasing use of skilfully provided ante natal supervision has been one of the most important From all hospitals, reports are in agreement that the infant mortality and maternal mortality and morbidity are far less among booked cases that is mothers who have received ante natal care than in the unbooked cases

A pregnant woman should have made her first ante natal visit by the 12th week of pregnancy At that visit a complete medical history will be taken and a full examination will be made Urine will be tested for abnormal constituents such as sugar and albumin and blood will be tested to make sure she has no anaemia (to which there is a peculiar tendency in pregnancy) or venereal disease Blood pressure will be measured The size of the uterus will be assessed and compared with what should be expected for the estimated duration of the pregnancy If the nipples of the breasts are retracted advice will be given to encourage the correction of this defect The woman will be given general advice on the sort of life she should lead and the sort of diet she should follow In Great Britain she will be given vitamins and iron tablets to ensure that she does not suffer from deficiencies of these factors Some clinics of course provide more extensive facilities than others but the foregoing can be regarded as representative

Subsequent visits are usually made monthly until about the 30th week then fortnightly until the 36th week then weekly until labour commences At these return visits blood pressure is recorded the urine is examined and the changes in the uterus associated with growth of

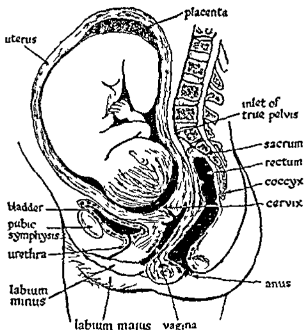
woman s strength for the voluntary efforts required during the second stage in which the uterine contractions become much stronger and have as their object the expulsion of the foetus through the birth canal In this process voluntary contractions of the abdominal muscles ( bearing down ) in fact actively assist the birth of the baby while the acquired ability to relax the muscles of the pelvic floor still further assists parturition It is easy to see, therefore how the ability to relax during the first stage and in between contractions during the second stage can be extremely helpful in determining an easy labour The months of pregnancy provide an ideal time for teaching and practising the art of relaxation so that having acquired it before labour is due the sensibly guided woman who has been inspired with confidence in her medical attendant is in a good position to undergo a labour which will be physiologically normal as well as comparatively free from discomfort We will return to this subject in the next chapter

There are of course many other psychological aspects of pregnancy The question of the phantom pregnancy has already been discussed and its association with fear of or intense desire for pregnancy has been mentioned Fear of pregnancy or perhaps more correctly fear of its consequences may precipitate frank mental illness in susceptible women Quite apart from fear pregnancy may precipitate a variety of psychological reactions The strange aberrations in appetite changes in libido and so on come under this heading Libido may disappear altogether during pregnancy this seems to be the primitive condition obtaining in most other animal species In some women it remains unchanged and in yet others it may be remarkably increased It is idle to regard any of these patterns as abnormal For the vast majority of women of course the psychology of pregnancy is intimately bound up with the desire more or less clearly expressed to give birth to children and to bring them up which is as essential a part of reproductive physiology as the production of the gametes themselves To analyse this desire is obviously outside the scope of this chapter

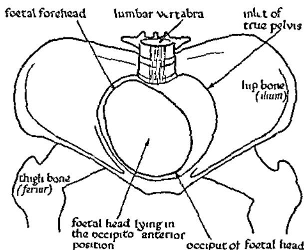
during labour, and what she herself might ordinarily have regarded as easily bearable discomfort may be turned into agonizing pain Fear also causes increased tension in the voluntary muscles and therefore can, during labour prevent their proper complementary efforts during the second stage A further undesirable effect is constriction of the arterioles leading to raised blood pressure this as we have seen may have very unfortunate effects during pregnancy

One of the major objects therefore of psychological care during pregnancy is to banish or at least to reduce fear Obviously far greater efforts will be required with some women than with others The emotionally stable mentally and physically healthy woman who has had a happy and sensible childhood an adolescence devoid of harmful incidents and who is happily married will look forward to the birth of her baby with many forms of emotion but fear is unlikely to be among them The chances of her having an easy, relatively painless labour are very high At the other extreme the unhappy neurotic woman, whose whole life has been an emotional burden whose ignorance of the changes of pregnancy and whose indoctrination in the terrors of childbirth by a spate of malicious old wives tales makes the approaching labour a terrifying adventure into the unknown is practically guaranteed to have a prolonged difficult and painful labour causing her medical attendant almost as much anxiety as she herself has suffered If however a woman is told what to expect if she has been told long before the onset of labour just what that process involves a great deal will have been achieved The extent of this achievement, of course will depend very largely upon the confidence with which the information is received Clearly it is one thing to be told that it is not going to hurt and quite another to believe it The ability to inspire confidence is certainly not possessed by all doctors let alone all obstetricians but the failure of one is no evidence against the success of others

In the scheme of ante natal care recommended by Read [79] along with the psychological approach outlined above a great deal of attention is paid to cultivating the art of muscular relaxation which that author considers to be of inestimable value for the accomplishment of natural childbirth As we shall see in the next chapter, the uterine contractions of the first stage of labour are concerned with bringing about dilatation of the cervix their intrusion into consciousness and interpretation therein as painful is far more likely if the voluntary muscles are in a state of tension The relaxed state also preserves the




A semi-diagrammatic sagittal section through the pelvis of a woman at full term with the foetus presenting in the occipito-anterior position The funnel shaped birth canal lying between the pubic symphysis in front and the sacrum behind and the cervix and vagina through which the foetus will pass during childbirth can be seen




This shows the inlet of the pelvis with the outline of a foetal head engaged in the left occipito anterior position

# IX

## CHILDBIRTH

We do not know what normally determines the onset of labour Both the growth of the foetus and hormonal changes are no doubt involved but no acceptable hypothesis explaining the start of labour covering all the facts has been possible

Before describing labour explanation of some essential technical terms must be made The presenting part of the foetus is that which will pass first through the birth canal this part is normally the vertex or highest point slightly behind the mid point of the head To present by the vertex therefore the foetus has to lie in the uterus so that its head is downwards and its neck is flexed the chin touching the chest The occiput is the back of the head this most commonly is directed forwards and to the left in respect of the mother the position then being called *left occiput anterior*

### NORMAL LABOUR

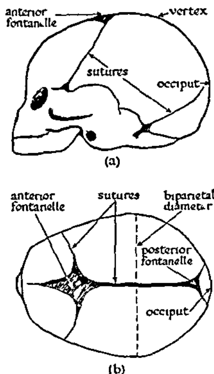
Labour may be considered to be normal when the foetus presents by the vertex, in an occipito anterior position is delivered alive by the natural forces and neither mother nor child sustains other than trivial injury

There are three factors involved in every labour namely the passages the passengers and the powers

*The passages* or the birth canal through which the foetus must pass consist of the cervix the true pelvis, and the soft parts that line the pelvic cavity and close its outlet

The inlet of the true pelvis is one of the narrowest parts of the birth canal in the normal pelvis If the head of the foetus which is the main obstacle to delivery can enter the inlet it will be able to pass through the cavity and outlet of the true pelvis The best fit between foetal head and pelvic inlet is obtained with the head lying obliquely with its widest

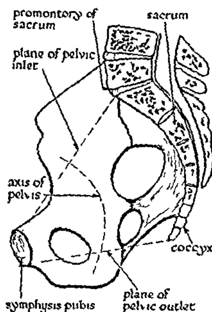
During parturition this muscle has first to undergo profound relaxation and stretching as the presenting part of the foetus advances through the pelvic diaphragm, and then when birth is actually occurring contraction of the levator helps to draw up the pelvic floor over the unborn parts of the foetus thus assisting their birth




The foetal skull (a) as seen from the side showing the relative positions of the vertex and occiput (b) as seen from above showing the anterior and posterior fontanelles and the widest diameter (the biparietal diameter)

*The passengers* are the foetus placenta and membranes For the consideration of the mechanism of birth the foetus consists of head trunk and extremities of these the head relatively large and only slightly compressible is as has been mentioned the critical part constituting the greatest obstacle to delivery The head consists of face and cranium its shape, as seen from above resembles that of an egg the greatest diameter being from front to back with its widest part nearer the back than the front The back of the head is a prominent

part, which is nearer the back than the front directed forwards However, since there is not always a tight fit, it is not surprising that X ray studies have suggested that in perhaps half the cases the head engages in a transverse position The cavity of the pelvis is, roughly, a short cylinder bent sharply forwards on itself so that the pelvic axis, an imaginary line marking the centre of the pelvic canal, extends first downwards and backwards, and then after bending forwards at the level of the ischial spines downwards and forwards The longest




The bony pelvis seen in sagittal section with the planes of the inlet and outlet and the pelvic axis marked out

diameter of the pelvic outlet is the antero-posterior one It follows therefore that as the head traverses the pelvic cavity it rotates from the oblique to the antero posterior position and changes its direction of descent from backwards at the start of descent to forwards as it emerges from the pelvic cavity

The outlet of the pelvis is closed by the pelvic floor through which the vagina passes The floor consists of muscles and connective tissue membranes Of the muscles the levator ani is the most important forming a funnel shaped elastic support to the pelvic contents Its contraction tends to raise the pelvic organs, and to constrict the vagina

levering action is exerted on the longer anterior part of the head than on the posterior part this increases flexion, pressing the chin closer to the chest and making the vertex of the head the part in contact with the cervix

In most women who have not previously borne children (primiparae) certain changes occur during the last 3 or 4 weeks of pregnancy The head engages in the inlet of the pelvis and as a result the uterus and its contents descend The fundus thus returns to the height it had reached perhaps a month before and the difficulty with breathing which may have been experienced is considerably relieved Mechanical interference with the functions of the stomach may likewise be relieved This descent is called lightening and once it has occurred the woman usually feels better than during the preceding few weeks Other symptoms however may replace some of those which have been relieved Thus the greater prominence of the lower abdomen and a sense of weight in the pelvis may interfere with walking while the pressure of the descending part causes increased bladder irritability Sometimes descent is accompanied by moderately strong uterine contractions these cause minor discomfort and are referred to as false labour since they are often mistaken for the start of the real thing If descent has not occurred in a primipara by the onset of labour the likelihood of disproportion between the head and the pelvic cavity or an abnormal presentation or position of the foetus is great and requires proper obstetrical attention In women who have previously borne children (multiparae) these changes do not occur because the lesser resistance of the uterine muscles and the comparative laxity of the abdominal wall allow the head to remain freely movable above the pelvic brim until the second stage of labour

### THE FIRST STAGE

The essential function of the first stage of labour is dilatation of the cervix to permit the passage through it of the presenting part Two distinct processes are involved in primiparae the first is effacement of the cervix and the second is dilatation of the external os Effacement is brought about by dilatation starting at the internal os so that the parallel sided cervical canal becomes transformed into a wider and wider funnel In this way the cervix assumes a thin membranous condition the external os still remaining more or less closed Subsequently the external os dilates fully also In multiparae effacement and dilatation

rounded feature, the occiput mentioned above The cranium consists of several thin bones, imperfectly ossified and united by strips of connective tissue called sutures These sutures are expanded in two places forming the diamond shaped anterior fontanelle and the triangular posterior fontanelle these can be felt in the young infant s head The structure of the cranium permits a good deal of moulding to occur during labour the shape of the head being modified so as to pass more easily through the birth canal In this way, normal labour is often accomplished even where the head before labour, might have appeared too large to traverse the pelvis

The other measurements of the foetus are of less importance being shorter than the essential diameters of the head Moreover the compressibility of the soft parts permits their easy passage in most labours Occasionally, however the birth of the shoulders is a little difficult and may require assistance from the obstetrician The birth of the placenta and membranes entails no anatomical difficulties

*The powers* are provided by muscular contraction exerted first by the upper segment of the uterus and after full dilatation of the cervix aided by voluntary contractions of the muscles of the abdominal wall Uterine contractions are involuntary, not under the control of the patient though there is no doubt that her emotional state may profoundly affect them

In approximately 95 per cent of full time labours, the foetus presents by the vertex other presentations will be mentioned later Since vertex presentation makes the prospect of straightforward labour far greater than does any other it may be asked how such a favourable situation comes to exist in so high a proportion of labours In the first place gravity probably plays a major part in determining the upside down attitude of the foetus since the head is relatively the heaviest part and in earlier pregnancy at least the foetus floats freely in the amniotic fluid Moreover the upper part of the uterus is more roomy than the lower part and since the pelvic extremity of the foetal ovoid (the buttocks when as is usually the case the legs are flexed) is its most bulky part, it tends to be forced into the upper part of the uterus by the intermittent contractions of the latter This factor of accommodation is also largely responsible for the flexed attitude of the head but an additional and important factor is provided by the fact that the head projects forwards from the neck farther than it does backwards The consequence is that as the foetus enlarges its head comes up against the obstruction formed by the inlet of the true pelvis and a greater

essentially painless labours can and do occur, especially in women from whom fear has been banished and who have an intelligent under standing of the processes that are going on

The regular uterine contractions increasing in intensity transmit their force through the liquor amnii equally in all directions Originat ing in the upper segment they tend to cause distension of the thinner elastic lower segment of the uterus and at the weakest point in the uterine wall—the internal os—they gradually produce the dilatation which starts the process of effacement As the foetus is gradually driven into the distending lower segment by the uterine contractions the upper segment retracts failing to relax to its previous dimensions this secures as it were the ground gained by each contraction When dilatation begins separation of the membranes over an area slightly larger than

internal and external os dilating at the same time

(a) (b)

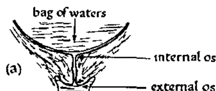
Dilatation of the cervix in the multiparous woman Stage (a) corresponds with stage (b) in the previous figure but dilatation is taking place both at the internal and external os In (b) the dilating action of the hydrostatic bag can be appreciated

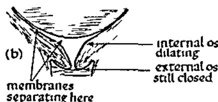
the expanding internal os occurs and a little bleeding may take place The blood mixed with cervical mucus passes through the vagina and appears as the show which indicates the commencement of cervical dilatation Once dilatation of the internal os has started another factor comes into play this is the hydrostatic bag formed by the projection of the membranes with their contained fluid into the funnel shaped cavity of the effacing cervix As the pressure within the bag rises during the uterine contractions the force is directed laterally thus aiding the obliteration of the cervical canal It is as though the door having been opened just a fraction the intruder (the hydrostatic bag) has its foot in and is levering the door still further open with it

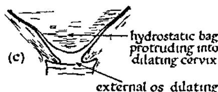
It seems probable that relaxation of the circular muscle fibres of the cervix is an important contributory factor to normal dilatation during the first stage especially during the dilatation of the external os

tend to proceed *pari passu* because of the varying amount of damage sustained during previous labours this alone accounts for a good deal of the reduction in the average duration of the first stage in multiparae

When labour commences the painless irregular contractions which have been occurring in the uterine muscle throughout pregnancy




Dilatation of the cervix in the primiparous woman in (a) the cervix is fully closed in (b) the internal os is dilating leading to effacement of the cervix and causing separation of the membranes from the uterine wall in (c) the external os is beginning to dilate and the hydrostatic bag is protruding into the opening cervix still further aiding dilatation by transmitting the pressure caused by uterine contractions downwards and outwards

become organized into stronger and more regular ones They soon intrude into consciousness but whether or not they are regarded as painful seems to depend a good deal on the woman s attitude towards them Nowadays the tendency is to avoid altogether using the term labour pains which naturally suggests that the contractions are painful —and so may induce the patient to regard them as such. It would be absurd to suppose that the pain of which many women complain during labour is entirely imaginary· what is undeniable however, is that

advance, the scalp of the head appears through the outlet and the head is said to have crowned Usually, the most advanced part is a swelling of the scalp which is formed as a result of the close fit of the head as it passes through the birth canal

We are now approaching the actual birth of the baby With each contraction, the perineum bulges and is stretched and thinned Finally the occiput slips under the pubic arch and successive contractions cause extension of the head so that the rest of the scalp the forehead face and chin appear in turn from under the perineum Usually in primiparae the greatly stretched perineum tends to tear, but if the birth of the head is not too rapid the tearing will be confined to the mucous membrane of the vagina If more extensive it will involve the skin of the perineum as well and if still more extensive it may extend into the rectum It is in order to avoid such uncontrolled tears and to substitute for their jagged uncertainty a clean circumscribed surgical wound that a diagonal cut in the stretched perineum (episiotomy) is often made by the obstetrician

After the birth of the head contractions may stop for a few minutes The head of the foetus now rotates back into the position it occupied before descent through the pelvic cavity began because the shoulders have remained in the original position the head having twisted on the neck As the contractions recommence further rotation of the head occurs so that the occiput comes to lie opposite one of the mother s thighs This is caused by the internal rotation of the shoulders which follow the course previously taken by the head In this way one shoulder is born from beneath the pubic arch and the other shoulder is born from under the perineum The rest of the body quickly follows bending sideways conforming to the curvature of the lower birth canal A gush of the remaining amniotic fluid completes the second stage of labour

The healthy new born baby soon starts to breathe and to cry the umbilical cord is then clamped tied and severed so freeing the infant from the placenta which is still inside the uterus

### THE THIRD STAGE

The retraction of the uterus which follows the birth of the child greatly decreases the area of attachment of the placenta When the shrinkage of the latter can no longer keep pace with uterine retraction placental separation occurs Bleeding takes place from the areas of

We will see later that interference with proper cervical relaxation may lead to unduly prolonged labour

At the start of labour contractions usually occur perhaps every 15 to 20 minutes as labour progresses, their frequency increases to once every 3 to 5 minutes at the end of the first stage Similarly, their duration increases from a few seconds to half a minute and their intensity also becomes much greater When pain is experienced it is usually felt first in the small of the back radiating round to the abdomen and down to the thighs Towards the end of the first stage, it is rare for the contractions to be unaccompanied by pain and if they have been painful from the start they usually become excruciating It is therefore in the latter part of the first stage that relief of pain (analgesia) in some form is nearly always required

Rupture of the membranes usually occurs towards the end of the first stage resulting in a sudden gush of amniotic fluid The vertex of the foetal head however blocks the dilated cervix so that a considerable proportion of the fluid is retained Sometimes the membranes rupture before labour has begun, resulting in dry labour, this is often difficult because of the abnormal condition which caused the early rupture Still more rarely, the membranes remain intact even throughout the second stage the child is then said to be born with a caul

### THE SECOND STAGE

At the end of the first stage there is usually a lull in the contractions which however soon return with increasing vigour Their character changes so that an overwhelming desire to bear down is experienced This involves fixing the diaphragm and forcibly contracting the abdominal muscles, and so long as the efforts coincide with the uterine contractions they very materially aid the progress of labour The effect of these muscular efforts voluntary and involuntary is to force the head of the foetus through the lower part of the pelvic cavity As it descends through the now fully dilated cervix it meets resistance from the funnel shaped elastic pelvic floor This causes internal rotation the head passes through an angle of 45 degrees so that the occiput comes to lie in the midline beneath the pubic arch With each contraction the head advances a little and soon the vulval outlet begins to bulge Between contractions the head recedes a little but as the foetus gradually passes out of the uterus the latter retracts thus securing most of the ground gained during contraction With further

consideration the subjective nature of the effects under review and these findings deserve respect.

There is surely no need to discuss the merits of the desire to relieve pain in childbirth in any case strong arguments can be advanced for the belief that the most natural of childbirths are comparatively easily achieved and entail little suffering An entirely different problem how ever, arises when a patient asks her doctor to ensure for her a painless childbirth. All analgesic or pain killing drugs and anaesthetics (which produce loss of consciousness as well) have an effect on the respiratory centre of the foetus and in addition may interfere with the normal progress of labour It may well be therefore that the quantity of drug necessary to ensure complete freedom from pain may introduce a serious hazard to the life of the baby either by prolonging labour unduly or by preventing the baby from breathing when it has been born No complete solution to this problem has been reached and it is possible that none may be found The object of obstetric analgesia *therefore* is to relieve the discomfort of labour to the greatest extent compatible with the safety of the child on the one hand a great deal can be achieved in this direction and on the other far too many mothers are denied the benefits of modern techniques which should be made available to them

A technical discussion of obstetric analgesia deserves no place in this book the reader requiring further information is strongly recom mended to consult *Relief of Pain in Childbirth* [74] It would be reason able however to consider a few general principles and to begin with we cannot do better than quote Professor Nixon and Dr Ransom from the above book

Criteria for a satisfactory method of obstetric analgesia have been formulated at different times We restate them according to current beliefs as follows

(1) The final result to the mother should be one that gives her the greatest satisfaction Pain can mar this but so can loss of memory There should be the minimum pain and none that she herself does not accept The most harmful pain is that which she does not understand and resents At times she may need sleep and forgetful ness some incidents she will want to remember
(2) The method should be harmless both to mother and child If drugs are used it should be remembered that all drugs of which we have any knowledge at present have unwanted side effects and must

separation and under the influence of further uterine contractions may help to extend them

At the finish of the second stage the uterine contractions cease and the woman usually feels a great sense of relief Within 15 to 20 minutes they begin again, though far less intensely than before The detached placenta and membranes are as a result, expelled from the uterus into the vagina where they may remain for some hours To avoid this, the woman is encouraged to bear down Provided no undue bleeding is occurring and the uterus is contracting satisfactorily all interference is best avoided until separation has occurred spontaneously When this has been accomplished the fundus of the uterus can be seen to rise in the abdomen

Sometimes the placenta fails to separate even though a patient, expectant course has been followed for some hours Manual removal may then become necessary but it requires great care and the strictest aseptic precautions to avoid the introduction of infection into the extensive raw area of the denuded interior of the uterus Retention of detached portions of placenta or membranes is also very undesirable because it predisposes to bleeding and infection For this reason the obstetrician always inspects the placenta and membranes carefully after delivery to make sure they are intact

### RELIEF OF PAIN

Mention was made in the last chapter of the potential benefit of psychological care during the antenatal period and of the help which a woman may receive during labour as a result of instruction in the art of relaxation while undergoing antenatal supervision There seems to be no doubt that many women thus guided may suffer so little dis comfort during labour that relief of pain by means of drugs is either unnecessary or easily achieved with minimal medication Goodrich and Thoms [40] published their experience of using the methods advocated by Read [79] in a series of 150 patients excellent or good results (some analgesia being necessary in the latter patients) were obtained among 80 per cent of the women fair and poor results in the remaining 20 per cent Of the 150 patients 48 were volunteers for this regime and in this group 89 per cent obtained excellent or good results In the remainder who were randomly chosen the benefits were not quite so great 77 per cent having been helped by the treatment This is a careful study as well controlled as could be taking into

atus and how to breathe through it before labour begins When the contractions have become painful as the end of the second stage is neared she inhales the gas as the contractions begin and stops doing so when the uterus relaxes and the pain passes off To obtain the full analgesic effect it is necessary to commence the inhalation before the pain begins and this requires some concentration of effort so as to anticipate the onset of pain this is a drawback since it keeps the idea of pain firmly in the patient s mind at a time when it would be far better for such mental effort to be avoided

More recently another inhalation anaesthetic trilene (trichloro ethylene) has come into extensive use This is a non inflammable volatile liquid which can be self administered by the patient with a less bulky apparatus than that necessary for nitrous oxide and air At the appropriate setting analgesia only is produced but by suitable adjustment of the apparatus full anaesthesia for obstetrical operations can be provided

It will readily be appreciated that the great advantage of inhalation analgesics and anaesthetics is the ease with which the amount administered can be varied according to requirements as well as the rapidity with which they are eliminated from the body which safeguards against overdosage Clearly with drugs administered by swallowing or by injection there is no means of *reducing* the effect if it proves to be greater than desired it is necessary to wait until the drug is eliminated from the body a process which is always much slower than with inhalation agents However a disadvantage of the latter is that some women object to or are afraid of breathing through a face mask and may find the smell of the analgesic unpleasant

One of the most widely used drugs today is pethidine this is usually given by injection and is a true analgesic which is particularly effective in obstetrics It relieves pain and also diminishes the patient s reaction to pain so that on the following day she may say that although she felt the pain she no longer cared about it and was able to relax well between contractions It has relatively few drawbacks and Nixon and Ransom [74] state On the whole we regard pethidine as generally the most useful analgesic drug for obstetric practice

therefore be administered in such a way that these unwanted effects shall remain latent The side effects that must be particularly avoided in labour are interference with the actions of the uterus and perineum, with the mother s co operation and expulsive powers and with the infant s respiratory and higher centres

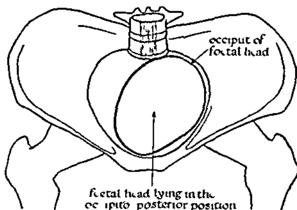
(3) The method must be practical The most effective methods consume time Each worker has to compromise with what he feels to be ideal and what he considers he has time for A simple method well carried out is better than a complicated one which has failed

The drugs used for relieving pain in childbirth may be grouped as hypnotics, which promote sleep (e g chloral hydrate paraldehyde bromethol [Avertin] and various barbiturates) analgesics or true pain killers (e g opium, morphine, heroin, pethidine) amnesics or drugs which obliterate the memory of events occurring while under their influence (e g hyoscine [scopolamine]) and the true anaesthetics which produce unconsciousness as well as analgesia (e g ether chloro form trilene) Another widely used agent is nitrous oxide ( gas ) mixed with air this will produce analgesia on inhalation though not un consciousness except when there is so little oxygen in the mixture that asphyxia also is produced

A method which enjoyed some favour twenty or more years ago, called twilight sleep , consisted in giving morphine and scopolamine at hourly intervals until the patient became amnesic She was restless during contractions but slept between them Much nursing care was necessary with this treatment and because of unco operativeness during the second stage the use of forceps for delivering the child was often necessary There is very little to recommend this method and many authorities condemn it

The inhalation of nitrous oxide and air, through an apparatus so designed as to prevent the patient from receiving an overdose and therefore permitting her to administer the analgesic to herself as she feels the need for it is probably one of the most useful advances in obstetric analgesia Various makes of portable apparatus are available the best known being Minnitt s In Great Britain to conform with the regulations of the Central Midwives Board—so that their use by midwives without medical supervision may be permitted—the gas mix ture delivered by these machines must not contain more than 50 per cent of nitrous oxide The most effective use of such a method by the mother requires that she should have become familiar with the appar

or by forceps with the patient fully anaesthetized Another manœuvre that has now gone completely out of fashion consisted in inserting a hand into the uterus pushing the head up out of the pelvic cavity grasping the feet and pulling them out through the cervix and finally delivering the baby as though it were a breech Where it is found that disproportion increases the difficulty of the baby s passage through the birth canal—and such disproportion albeit of minor degree is a com mon contributory cause to persistence of the occipito-posterior position—recourse is usually had to Caesarian section preferably before the mother has been exhausted by a prolonged unprogressive labour and before the baby s life has thereby been placed in jeopardy




The inlet of the true pelvis with the outline of a foetal head engaged in the left occipito posterior position Compare with the figure on page 103 and note how the head is a less good fit in this position

When labour has commenced in the occiput posterior position rota tion has begun spontaneously but has progressed through 45 degrees only and then stops deep transverse arrest is said to exist It becomes necessary for the obstetrician to complete the rotation manually and then to deliver the child with forceps

Malpresentations arise when the vertex is not lying over the internal os If the degree of flexion of the head on the trunk is incomplete presentation may be by the brow or by the face these representing increasing degrees of head extension In all cases increased circumfer ences of the head are brought into opposition with the circumferences of the birth canal adding to the resistance of passage or preventing

# X

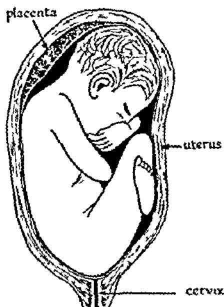
## SPECIAL PROBLEMS OF CHILDBIRTH

THE definition of normal labour was given on page 102 all other labours therefore are abnormal As such the proper place for their full discussion is a text book of obstetrics here we will merely undertake an illustrative survey

### ABNORMALITIES OF PRESENTATION AND POSITION

Abnormalities of presentation and position account for most instances of abnormal mechanism of labour (dystocia) The important thing is that the doctor should not only recognize abnormal presentations of the foetus but also malpositions even though presentation is normal In these there are nearly always early rupture of the membranes poor uterine contractions slow cervical dilatation and delayed engagement of the head or even complete failure of engagement The commonest and most important in this group is the malposition called occipito posterior in which the back of the foetal head is directed towards the mother s back Estimates of its frequency vary but 20–25 per cent is usually regarded as fairly accurate in contrast breech presentation (in which the buttocks of the foetus not its head form the presenting part) the next most common anomaly has a frequency of only 3 to 4 per cent Most cases of occipito-posterior position obviously undergo spon taneous rotation so that the baby is born in the normal anterior posi tion *When the position is persistent* slow and difficult labour precedes the birth of the baby sunny side up —face to pubis or may end in deep transverse arrest (see below) The skilful obstetrician will maintain a carefully watchful attitude in these cases since the risks of foetal d ath or serious damage and of the mother sustaining serious injury to the birth canal are greatly increased if it becomes necessary he will interfere Various manœuvres have been devised to achieve rotation of the head once the first stage is completed this can be done manually

of the head is assisted with forceps The main dangers to the baby of breech delivery are death for the reasons given above fractures of bones especially the humerus in the arm and injury to the large nerve




A semi-diagrammatic section of a uterus containing a foetus presenting by the breech (Compare with the figure on page 103)

trunks passing from the neck to the arm (the brachial plexus) resulting in Erb s paralysis in which the arm hangs limp at the side usually with the hand turned inwards and backwards Recovery from this last injury usually occurs

### PREMATURE LABOUR

A foetus born at or after the 28th week of pregnancy may survive when labour occurs after the 28th week and before full time at 40 weeks it is said to be premature The uterine contractions are apt to be irregular and inefficient abnormal presentations are common the third stage may be anomalous separation of the placenta being slow and excessive bleeding following because of poor uterine contractions the

it altogether Once again, accurate and timely diagnosis permits the obstetrician to convert the abnormal presentation into a normal one by the vertex to turn the foetus so that it presents as a breech and is extracted as such, or to deliver by Caesarian section

The two remaining malpresentations are breech and shoulder presentation In the former, the buttocks of the foetus are in the lower uterine segment the head in the fundus as mentioned above In the latter called cross birth the long axis of the foetus lies across the long axis of the uterus the head usually being directed downwards and to one side with the buttocks at a higher level on the other side The causes of these abnormal presentations cannot always be determined Some of the predisposing causes are a large relaxed uterus a weakened pelvic floor (usually the result of many previous labours) twins, foetal abnormalities an abnormally large or small child (breech presentations are much commoner in premature labours) foetal death in utero placenta praevia, where the placenta is attached low down in the uterus instead of at the fundus and abnormalities of the pelvis reducing the size of the pelvic cavity There are many others

Breech presentation the commonest type of malpresentation requires further discussion Its incidence is about 3 or 4 per cent of all labours The outlook for the mother is not quite so good as with vertex presentations and for the child is definitely less good especially in first labours The presenting part the buttocks, is much less efficient a cervical dilator and so the first stage is often prolonged moreover since as in all abnormal presentations, early rupture of the membranes usually occurs further difficulty in labour is introduced An additional difficulty is encountered in the delivery of the head, once the trunk has been delivered if the delay is too great the child may die by suffocation or from bleeding into the brain

Because of the drawbacks to breech delivery it is usual in the later stages of pregnancy to attempt to turn the baby so that it presents by the vertex This is successful in about 50 per cent of cases though not a few of such turned babies return to the breech position before labour commences Caesarian section is sometimes undertaken to avoid the risks of breech delivery but of course has risks of its own Various obstetrical procedures are employed to reduce the length of the second stage when this is not proceeding satisfactorily; they constitute breech extraction and involve hooking the fingers first around the baby s groins so as to assist birth of the buttocks and legs then round the shoulders to assist their birth and that of the head Very often delivery

labour. Primary inertia is the condition wherein, from the start, the contractions have been ineffective; secondary inertia exists when labour has been more or less normal, but the effectiveness of the contractions has become less and less. Inertia can be of two kinds, hypotonic, in which the force of the contractions is inadequate, and hypertonic, in which there is relative failure of the uterus to relax between contractions.

Some of the causes of inertia have already been discussed—such as overdistension of the uterus due to excessive size of the contents, premature labour, malpresentation and so on. Other causes are abnormality of position of the uterus, congenital uterine malformations, excessive obesity, etc. Inertia is almost exclusively an abnormality of primiparae. This in itself is suggestive—that the principal trouble lies in the difficulty of dilating the cervix which has never undergone previous dilatation and is, in fact, merely an extension of the difference existing between the average primiparous and multiparous first stages. It seems probable that quite apart from the efficiency of the uterine contractions, the inability of the cervix to relax is an important aspect of inertia. There is good reason to suppose that the woman's emotional state may have important effects on this aspect, since cervical relaxation is hindered by overactivity of the sympathetic nervous system which, of course, is the case in states of fear and nervous tension. In the hypotonic form of primary inertia, rather different considerations apply, and the problem is not so much what is preventing dilatation of the cervix as what is preventing the development of strong, effective uterine contractions. Sometimes the answer to this question is clear enough, but all too often it remains unexplained, largely, perhaps, because, as pointed out at the beginning of chapter IX, we do not know what starts labour going.

Occasionally in multiparous women the child is born very rapidly. It is extremely uncommon for this to happen with first births. The powers may be excessive and the resistance subnormal. There may be so little warning that the child is born in the absence of an attendant. Sometimes the cord may be torn [illegible] with serious consequences. For example, the cord [illegible] The mother too is likely [illegible] child may be injured as it literally falls out. The mother [illegible] suffer perineal laceration and there may be [illegible]

CONTRACTED PELVIS

A further cause of abnormal [illegible] been made in passing is difficulty [illegible]

child is at first very delicate, requiring careful temperature regulation and feeding, as well perhaps, as oxygen to assist the shallow inefficient respiration

## MULTIPLE PREGNANCY

In multiple pregnancies because of the bulky contents of the uterus —often still further increased by the presence of hydramnios—labour is apt to be premature and the babies to be considerably und rsi e However, perhaps because of the excessive distension of the uterus the contractions are feeble and irregular and a prolonged labour results After the expulsion of the first child there follows an interval sometimes of a few minutes only, but occasionally of some days, if no aid is given, before labour is resumed and the second child is born If more than twins are present this process is of course, repeated Usually, the placentae do not separate until all the children are born but rarely they may become detached and delivered after the first baby In such an event only the most prompt delivery of the second child would avert its death from asphyxia The likelihood of severe bleeding from the uterus after the birth is increased, because of poor uterine contraction and the larger placental area

Very occasionally one twin may interfere mechanically with the birth of the other Such cases of locked twins have been encountered in which birth of the first baby has started by the breech but its head has become hooked with the head of the other twin at the pelvic brim preventing further descent As a last resort it has sometimes been necessary to destroy one of the twins in order to permit delivery of both

The outlook for the mother is less good in multiple pregnancy Dangers arise from the greater incidence of toxaemia during pregnancy of exhaustion post partum haemorrhage and puerperal infection during labour and from the frequent necessity to use various obstetrical manipulations The babies usually small and premature do not stand long labour and operative delivery very well consequently the foetal mortality of twins is considerably higher than in mature single pregnancy and is far greater with triplets and quadruplets

## *ABNORMALITIES OF THE POWERS*

One of the outstanding unsolved problems of obstetrics is uterine inertia in which the uterine contractions fail to result in progression of

labour Primary inertia is the condition wherein from the start contractions have been ineffective secondary inertia exists when labour has begun more or less normally but the effectiveness of the contractions has later become less and less Inertia can be of two kinds hypotonic in which the force of the contractions is inadequate and hypertonic in which there is relative failure of the uterus to relax between contractions

Some of the causes of inertia have already been discussed—such as overdistension of the uterus due to excessive size of the contents premature labour malpresentation and so on Other causes are abnormality of position of the uterus congenital uterine malformations excessive obesity, etc Inertia is almost exclusively an abnormality of primiparae This in itself is suggestive—that the principal trouble lies in the difficulty of dilating the cervix which has never undergone previous dilatation and is in fact merely an extension of the difference existing between the average primiparous and multiparous first stages It seems probable that quite apart from the efficiency of the uterine contractions the inability of the cervix to relax is an important aspect of inertia There is good reason to suppose that the woman s emotional state may have important effects on this aspect since cervical relaxation is hindered by overactivity of the sympathetic nervous system which of course is the case in states of fear and nervous tension In the hypotonic form of primary inertia rather different considerations apply and the problem is not so much what is preventing dilatation of the cervix as what is preventing the development of strong effective uterine contractions Sometimes the answer to this question is clear enough but all too often it remains unexplained largely perhaps because as pointed out at the beginning of chapter IX we do not know what starts labour going

Occasionally in multiparous women the child is born very rapidly It is extremely uncommon for this to happen with first births The powers may be excessive and the resistance subnormal There may be so little warning that the child is born in the absence of an attendant sometimes with serious consequences For example the cord may be torn or the child may be injured as it literally falls out The mother too is likely to suffer perineal laceration and there may be bleeding from the lacerations

## CONTRACTED PELVIS

A further cause of abnormal birth to which reference has already been made in passing is deformity of the bones of the pelvis reducing

some of the diameters of the true pelvis so as to make the passage of the foetal head through it difficult or impossible Its importance lies in the high incidence of the condition especially in undernourished communities Thus in a series of 6 407 white and 5 223 coloured women in the United States J Whitridge Williams (quoted by Barnes [9]) found approximately 14 and 44 per cent respectively of contracted pelves Causes include rickets—*first and foremost bone diseases such as* tuberculosis and osteomyelitis fractures poliomyelitis re ulting in bony deformity through abnormal muscle action and so on Any disease interfering seriously with general bodily activity during childhood and *adolescence is liable to disturb the normal development of the pelvis* and to result in deformities which may cause dystocia

A pelvis may be contracted at the inlet the outlet in the cavity or in more than one of these The generally contracted pelvis is smaller than *normal in all its diameters but otherwise of normal shape The android* type of pelvis is similar to that found in the male and has a relatively small cavity The flat pelvis has a shortened anteroposterior diameter throughout it is said to be caused by carrying heavy weights in girlhood —and the increased incidence in countries where this practice is frequent would seem to support this hypothesis though of course there may be other more important factors The rachitic flat pelvis resembles the simple flat pelvis but has a flattened sacrum which is rotated backwards and in spite of its narrowed inlet has a roomy outlet The most extreme degrees of contraction arise in severely undernourished women, giving rise to generally contracted rachitic pelves Occasionally marked asymmetry of the pelvis may lead to obstetric difficulties The funnel pelvis, in which the inlet is normal but progressive narrowing occurs towards the outlet may be sinister because it will permit normal engagement of the head but will not allow its passage through the outlet

Apart from the obvious dangers introduced into obstetrics by the presence of a contracted pelvis various other complications may arise Occasionally in early pregnancy a malformed pelvis may cause incarceration of the growing uterus Later in pregnancy the reduced capacity of the pelvic cavity results in the uterus rising higher than normally distending the abdomen and embarrassing circulation and respiration The uterus will be more freely movable and so may cause considerable discomfort through pressure on nerve trunks impedance of the venous return from the legs may increase the risk of development of varicose veins Abnormalities of presentation and position of the foetus are more frequent than with normal pelves Where the degree of contraction is so

great as to render the birth of a living child impossible or improbable, the doctor should not allow labour to start but a Caesarian section should be performed electively at the most convenient time Where only minor degrees of contraction have been found on measurement and X ray examination (pelvimetry) a trial of labour is often permitted labour is then allowed to continue so long as it is making satisfactory progress the condition of the foetus is remaining good and the mother is not becoming exhausted The first stage may then be accomplished satisfactorily and the delivery completed by forceps If on the other hand progress ceases the wise obstetrician does not allow an ineffective labour to drag on resulting in distress to the foetus exhaustion of the mother and increasing the risk of infection he promptly terminates by Caesarian section

## FORCEPS

Repeated reference has been made in the preceding pages to delivery with forceps so that some explanation of what this involves seems desirable Bethel Solomons [96] one of the foremost authorities on obstetric forceps has written

'The forceps as an aid in obstetrics are said to be one of the most useful instruments ever invented They are said to have helped more women in childbirth than anything else While this is all true yet the havoc wrought by ignorance of the instrument and its application is enough to make one wonder whether women would have been better off without forceps

Historically the first recognizable forceps appear to have been those of Albucasis (936–1013) though there can be no doubt that they could only have been used for extracting dead foetuses The Chamberlen family who lived in England during the sixteenth and seventeenth centuries were probably the first to use obstetric forceps for delivering live babies They kept their technique a closely guarded secret and had they lived at the present time would have been rejected by all scientific circles for refusing to disclose their methods which undoubtedly were of great benefit in the state of knowledge as it then existed There is a well known incident in which Hugh Chamberlen in 1670 attempted in the presence of Mauriceau one of the outstanding obstetricians of the time to deliver a rachitic dwarf with his forceps and failed not only in this endeavour but also to sell the invention to the Frenchman Later

one of the family sold the secret for a large sum to a Dutchman Roger Roonhuysen, who formed a company of doctors to exploit the instrument This detestable custom was maintained for 70 years until the *technique was made public by Hugo de Poll*

The main legitimate use of the forceps is as a tractor, that is to draw the foetus out Before forceps are applied the cervix has to be fully dilated the head should be engaged within the inlet of the pelvis in a suitable position the membranes should be ruptured, the bladder and rectum should be empty and in general the child should be alive Occasional exceptions to these rules arise—but they are *very* occasional It follows therefore that use of the forceps is by no means the solution to all obstetrical problems The reasons for applying the forceps are, briefly the appearance of signs of danger to the child, or to the mother

The application of forceps requires full though not deep anaesthetization of the patient and scrupulous asepsis Each of the two blades is applied separately and to avoid damage to the baby the precise position of its head in the pelvic cavity should be known to the obstetrician The blades fit one on each side of the head so that when the two halves of the forceps have been locked together, the obstetrician is able to exert a steady pull on the foetal head thus gradually bringing it down through the birth canal The force required is not great, though it may have to be exerted for some time brute force leads only to disaster Attempts to overcome bony resistance with forceps are doomed to utter failure the sinister statistics published by Miller [*71*]—29 maternal and 125 foetal deaths in a series of 558 cases of failed forceps from three different hospitals—show only too clearly how ignorance of the proper use of forceps can lead to the most deplorable results

The undesirable effects of forceps on the foetus are more frequently seen and are more severe the higher in the birth canal is the head at the time of application The commonest injury apart from superficial scratches is facial palsy (seen as paralysis of the muscles of the face usually on one side only) but fortunately this usually soon recovers Far more serious is bleeding into the brain which may either result in neonatal death or later in the appearance of imbecility Against the reduced risk of damage to the foetus by forceps application when the head has descended to a low level in the pelvis must be set the greater risk of foetal death before delivery when application is delayed unduly In difficult cases therefore the determination of the best moment to apply the forceps may require the most experienced judgement To the mother the risks of injury to the perineum vagina and cervix become

progressively greater, the higher is the application of forceps Once again therefore provided waiting itself does not entail still greater risks everything is to be gained by delaying application of forceps as long as possible

### CAESARIAN SECTION

The most spectacular of all obstetric operations is without doubt Caesarian section or the delivery of a live baby by opening the mother s abdomen and uterus The name of the operation is derived from the reputed fact that Julius Caesar was so delivered after his mother had died before the completion of labour Such a situation arises very rarely in obstetric practice the value of the operation as performed nowadays is that it makes possible delivery of a live baby with little added risk to the mother in circumstances in which birth by the natural passages would be impossible or would involve grave danger to the baby the mother or both The risks to the mother of the operation though comparatively small in skilled hands are very real when it is performed imperfectly and in unsatisfactory surroundings The main dangers are haemorrhage and infection in proper hospital practice with modern blood transfusion facilities and antibiotics these dangers can be kept to a minimum Nevertheless a maternal mortality from the operation varying between 0 1 and 1 per cent is reported from different centres

The principal indications for Caesarian section are pelvic deformity preventing the passage of the baby including disproportion where although the pelvis is normal the foetus is too large to pass through placenta praevia where to allow labour to commence would risk sudden severe haemorrhage which might be rapidly fatal premature separation of the placenta the elderly primigravida where it is feared that a long and difficult labour might lead to loss of the child and a subsequent chance of conception might not occur certain chronic or constitutional diseases in which the efforts of labour might prove highly dangerous to the mother soft tissue obstructions—such as tumours—of the birth canal and adjacent organs making delivery from below impossible and certain cases of late pregnancy toxaemia

The risk of infection in Caesarian section has been mentioned this does not arise in the elective operation carried out when the obstetrician decides the time is ripe before the onset of labour Once labour has begun however and especially if the membranes have ruptured the

possibility of infection of the uterus exists and the longer labour has been in progress particularly if various manipulations, including perhaps the application of forceps have been made the greater is the probability of infection The danger from Caesarian section then arises through spreading the infection to parts outside the uterus This risk though much reduced by the use of antibiotics such as penicillin aureomycin and so on can never be neglected

Two main varieties of operation are used the classical operation and the lower segment operation in its various forms In the first type the abdomen is opened and then a longitudinal incision is made in the body of the uterus the baby is then extracted followed by the placenta The uterus is then sutured in three layers returned to the abdomen and the wound in the latter is closed In the lower segment operations the uterus is opened low down with dissection of the bladder from the utero-cervical junction Otherwise the procedure is basically similar to that of the classical operation The lower segment operations are favoured nowadays because they tend to provide a firmer uterine scar, there is less bleeding and the risk of infection of the peritoneal cavity is reduced On the other hand they are more difficult to carry out and the interval between commencing the operation and delivering the baby is longer than with the classical operation Various other types of operation have been devised for special circumstances such as frankly infected cases but their details need not concern us here

A question frequently asked is must a woman who has been delivered by Caesarian section always be similarly delivered in subsequent pregnancies? The answer depends a good deal upon the circumstances of the first operation If it was performed for an indication such as pelvic contraction which would exist in all future pregnancies then clearly Caesarian section would be just as advisable for them as it was for the first If on the other hand the indication was for example placenta praevia and this was not present at a subsequent pregnancy the need for a Caesarian delivery would not necessarily exist Indeed in such a case the only cause for apprehension if all the other obstetric factors were satisfactory would be the possibility of rupture of the uterus through the scar of the former operation This risk is generally considered to be appreciably greater after the classical than after the lower segment operation Consequently many obstetricians would advise repeating Caesarian section in all cases where a classical operation had previously been performed but might permit normal delivery if a lower segment operation had been used Another consideration of some

weight would be whether the first operation had been done before or during labour if labour had not started then in her subsequent pregnancy, the woman would be comparable to a primipara in so far as no cervical dilatation would have occurred so that a relatively prolonged first stage with consequently greater strain on the operation scar would be *anticipated* On the other hand if cervical dilatation had been accomplished before the operation was made then a subsequent pregnancy would more closely resemble that of a multipara with its shorter easier first stage and therefore lessened risk of rupture through the uterine scar

SOME OTHER OBSTETRIC PROCEDURES

It sometimes becomes advisable to induce labour before it begins spontaneously Usually the attempt is first made by medical means the patient being given a dose of castor oil a hot bath an enema and injections of posterior pituitary extract Sometimes this fails and surgical induction is then employed The simplest form of this is rupture of the membranes following which labour usually proceeds quite satisfactorily (paradoxically for it will be remembered that in most malpositions and malpresentations early rupture of the membranes occurs while subsequent slow and inefficient labour follows but in these cases the malposition is itself the cause both of the early rupture and of the slow labour)

We have already mentioned episiotomy or cutting the distended perineum during the birth of the head It is frequently done in primiparae when undue stretching of the perineum is to be avoided and when it is feared that a tear may otherwise result Clearly a clean surgical wound is preferable to a ragged irregular tear is easier to repair and more likely to heal with negligible scarring A properly timed and executed episiotomy will nearly always prevent a third degree tear a rather dreaded complication of parturition Such a tear extends backwards so as to involve the rectum It is difficult to repair properly and if the anal sphincter is not restored much future trouble may be experienced by the unfortunate victim

On certain occasions it may be necessary to destroy the foetus in order to save the mother s life There is no doubt that this situation is faced fairly frequently in *early* pregnancy, the doctor being confronted with the alternatives of allowing the pregnancy to continue with the grave risk of losing both the mother *and* the child or of advising termination

possibility of infection of the uterus exists and the longer labour has been in progress, particularly if various manipulations including perhaps the application of forceps have been made the greater is the probability of infection The danger from Caesarian section then arises through spreading the infection to parts outside the uterus This risk though much reduced by the use of antibiotics such as penicillin aureomycin and so on can never be neglected

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# XI

## BREAST FEEDING

PREPARATIONS for breast feeding begin physiologically during pregnancy and part of the ante natal care should be directed towards the future prospect of lactation It has already been described how changes occur in the breasts during each menstrual cycle under the influence it is generally supposed of oestrogen and progesterone These changes proceed in an enhanced degree during pregnancy and lead to a great expansion of the glandular tissues of the breasts providing for the actual secretion of milk During the last weeks of pregnancy some secretion of milk actually occurs but it is small in amount and differs from the milk produced during established lactation in several ways It is called colostrum and is thick viscid and yellowish it was formerly thought to contain important antibodies which transmitted immunity to certain diseases from the mother to the baby but this view is no longer held

There is some reason to believe that colostrum may sometimes block the lactiferous ducts and so predispose to the development of a painful condition called engorgement when full secretion of milk starts a few days after delivery For this reason mothers are well advised to practise manual expression of colostrum from the breast before the end of the pregnancy this early acquisition of the technique also has the advantage that the mother knows how to carry it out during the early stages of lactation when hand expression is often desirable in addition to the infant s suckling so as to promote the secretion of milk When ante-natal expression is practised the scanty milk secretion of the first few days after delivery is not thick like ordinary colostrum but more closely resembles milk

It would seem that all the essential hormones required for milk secretion are present during pregnancy (the fact that milk *is* secreted during this time supports such a belief) but evidently an inhibiting factor also must be operating since full secretion starts only after

of the pregnancy which of course involves the death of the foetus Religious motives may deter some from taking the latter course but opinion generally overwhelmingly endorses the propriety of advising what is necessary to safeguard the mother s health In popular discussions however this is not the situation usually in mind since in it the arguments in favour of putting the mother first seem so unassailable Rather the mother at full term, unable to deliver her baby and faced with dying in the attempt, is the picture envisaged For the obstetrician however this has little meaning since in properly conducted practice it almost never arises some well recognized obstetric procedure or other is available to meet all the probable (and many improbable) circumstances offering a good chance of producing a live baby and of course leaving the mother in a safe condition Destruction of the foetus at or near term, therefore is confined to a few rare situations where the *child being dead* disproportion or some other factor is preventing normal delivery through the vagina or where a live monstrosity is by its very nature preventing its own natural delivery

uterus This is a reason for encouraging suckling during the first few days after delivery when there is very little milk secretion since the contractions favour return of the uterus to its normal state The let down reflex is subject to the influences which affect reflex action in general Thus it can become conditioned so that for example the mother has merely to make the preparation for feeding her baby for let-down to occur or once regular feeding has been in progress for a little time let-down may occur automatically at regular intervals On the other hand it can be inhibited in various ways for instance by awkward and embarrassing circumstances during feeding deeply in grained dislike of feeding or worry One may mention particularly unsought advice from neighbours and relatives (which usually conflicts with that given by the doctor) As a result feeding may become unsatis factory and eventually fail altogether In her book on Breast Feeding Dr Charlotte F Naish [72] deals very fully with these all important psychological aspects of lactation

Engorgement of the breasts may occur at any time after the third day The breasts become hard tense and painful with dilated veins visible beneath the surface They feel hot and the patient may be feverish The baby s attempts to obtain milk are ineffective and all other forms of milking prove painful and difficult If the condition is allowed to persist for even a few days the future supply of milk is usually doomed Many mothers whose milk failed about the third week believe that it was because they had too much to start with but closer enquiry usually reveals that they suffered from engorgement It has been held that en gorgement was due to overfilling of the breasts with milk which could not escape because the ducts were blocked with thickened earlier secre tions and that systematic manual expression ante natally would prevent it [*106*] Naish however while agreeing with the value of ante natal expression considers that the engorged breast is not over full of milk but of blood and that the reason why the milk cannot be withdrawn is that the ducts are closed by the raised pressure in the congested tissues around them [*72*] It is probable that a great increase in the blood supply is a necessary accompaniment of full secretory activity the con gestion may be due to defective circulation in tissues never fully active before The far greater incidence of engorgement in primiparous than in multiparous women certainly supports this view the value of ante natal expression may partly be due to its improving the local circulation Frequent short milking by gentle manual expression and massage of the breasts seems to be the most effective way of dealing with engorgement

delivery The placental oestrogens most probably constitute this inhibiting factor After delivery, there is a sudden and profound fall in oestrogens—in fact examination of vaginal smears during the first week after delivery usually reveals a picture similar to that found in women long past the menopause As a result of this it is possible that the anterior pituitary gland undergoes a sudden burst of activity, or else releases stored hormones producing a flood of prolactin This, it seems triggers the secretion of milk in substantial quantities

The interval between delivery and the development of full secretion averages 3 days but may be considerably longer in some women who may eventually lactate satisfactorily just the same One cannot therefore too strongly condemn the ignorant practice in some institutions of commencing artificial feeding within a few days of delivery because the mother did not have enough milk —when in fact she was never given the opportunity of producing any Once started milk secretion continues until the rising milk pressure in the ducts approaches the pressure of blood in the capillaries supplying the secretory cells Secretion then ceases It thus follows that during the first week or so of established milk secretion when the baby may be unable to take more than a fraction of the total milk available unless most of the remaining milk is expressed manually the total quantity secreted will soon fall and so may later become inadequate This manual expression therefore at the end of each feed helps to increase the milk yield and most women are thereby enabled to produce far more milk than is actually needed for their own baby

In addition to the secretion of milk, its flow from the breast must also be considered Dairy farmers have long been familiar with 'the draught or let down but the existence of a similar phenomenon in women has only recently been widely appreciated Stimulation of the nipple and areola of the breast as by the baby s sucking or with the fingers is normally shortly followed by a rapid flow of milk which may even be ejected quite forcibly from the nipple—and from the other breast also This is brought about by a reflex Nervous impulses are conveyed from the sense organs in the nipple and areola to the cortex of the brain thence a relay goes to the hypothalamus where a further relay conveys impulses to the posterior pituitary gland which secretes its hormone into the blood stream The posterior pituitary hormone reaches the breasts and causes contraction of the myoepithelial cells of the ducts (so called because they contract like muscle cells as well as line the ducts) so expressing the milk It also causes contractions of the

supplementary feeding with artificial food or where necessary, the complete substitution of artificial for natural feeding is obviously the correct course The unreasoning insistence upon breast feeding at all costs regardless of the welfare of the baby (and occasionally even of the mother) is just as foolish as the *preference* for artificial rather than natural feeding

the earlier treatment is begun the more likely is it to be successful and to prevent failure of lactation Failure of lactation may occur for various other reasons Ill advised technique lack of perseverance, and psychological factors are the commonest causes

Finally, since the question is often asked we may justifiably consider why a woman should be encouraged to feed her baby rather than to rely on artificial feeding It is perhaps extraordinary that there should be any need to debate the matter but there is no doubt that, in some countries at least notably the United States of America, the possibility that a woman might *want* to feed her baby is scarcely even considered As a result the advocators of breast feeding often find themselves compelled to demonstrate the advantages of the natural method over an artificial one—the reverse of the situation in all other comparisons of artificial versus natural methods

In the first place until an infant is weaned on to solid food its continued existence is absolutely dependent on outside assistance for which purpose the mother is specifically equipped by her ability to feed her baby at her breast Reproduction therefore quite legitimately embraces lactation Breast milk is clean safe, at the right temperature of the right composition and available without special preparations To produce an artificial feed of even approximately similar composition and hygienic standard requires a good deal of time and trouble it is therefore quite remarkable that anyone should prefer to do this Indeed those who choose artificial feeding seldom do take the necessary trouble but take a chance instead The question of composition could be considered at much greater length, but it will suffice to say that no amount of preparation will produce an artificial feed exactly resembling human milk which of course is perfectly matched to the digestive abilities of the average infant Most artificial feeds bear only a superficial resemblance in composition to human milk

It is probable that the psychological effects on the infant of breast feeding are of far greater value than is generally appreciated The incidence of intestinal disorders chiefly due to infection from ingested bacteria is considerably higher in artificial than in breast fed infants and the death rate from this cause is consequently higher too in the artificially fed babies [27 39 93] It has been concluded by Cruikshank that some 80 per cent of mothers could beneficially feed their babies for the first six months with a material reduction of infant morbidity and mortality [23] The remaining 20 per cent are probably unable for various good reasons, to feed their babies adequately and for these

Fertility and infertility are not attributes which can be described in absolute terms Every gradation exists both for male and female between the highest levels of fertility and complete sterility The restriction of mating in human society occasioned by the usual marital practices introduces a further complication because husband and wife must be regarded as a reproductive unit Clearly if one partner is completely sterile the union will be sterile regardless of the fertility of the other partner A highly fertile wife however, may make up for a relatively infertile husband and vice versa so that they may either produce one child only or a small number with some difficulty Had the degree of fertility in both partners been equally low no offspring at all might have resulted It is estimated that about 7 per cent of married couples in Western countries have fertility problems finding themselves either unable to produce children or else unable to produce as many as they want The apportionment of the fault to husband and wife in these cases is roughly one third to the former alone one third to the latter alone and one third to both partners together

The attitude of married couples to childbearing is of course very variable Nowadays, the majority do not wish to have children during the first few years of their marriage mainly for economic reasons and because of housing difficulties Some form of contraception is therefore usually practised at first Sooner or later either wife husband or both feel that they would like to have a baby and contraception is abandoned Some women conceive within a month or two of the commencement of regular intercourse without contraceptives but 6 months may be taken as a reasonable average period for such intercourse, before pregnancy may be expected Opinions differ on the length of the period of unproductive intercourse before medical advice should be given some authorities suggest two years some three years and others that it should be given as soon as sought This they point out is because a fairly high proportion of the couples seeking advice will be found on investigation either to be seriously subfertile or to be in need of active medical assistance If such couples are merely told to keep on trying for another two years before returning should they still be unsuccessful and are then found to be subfertile on investigation they will clearly not have been well advised in the first place

When the eagerness to reproduce is very great—as is quite commonly the case—the desire to leave no stone unturned may make such couples easy prey to the unscrupulous or raise serious problems for the conscientious practitioner who has their mental well being as well as their

## XII

## FERTILITY AND INFERTILITY

In primitive society childbearing is regarded as a *natural* function of the women and failure of this function has automatically been regarded as due to some fault in the woman Since moreover, in such society a high reproductive rate is nearly always advantageous—to offset the accompanying high reproductive wastage, great frequency of disease inefficiency of manual labour for farming hunting and so on and to provide manpower for protection against human as well as animal enemies—high fertility is regarded as a laudable quality and infertility as correspondingly shameful Historically these considerations have for the most part been equally applicable in civilized society until recently when falling death rates due mainly to medical advances and rising populations together with demands for higher standards of living by the majority have brought about changes in viewpoint towards the size of the family This subject will receive further attention later but from our present point of view the important outcome is that since less of a premium is now placed on fertility, more attention is being paid to infertility With the fall in prestige formerly associated with a large family, the shame of barrenness has disappeared but at the same time the demand for medical assistance where natural reproductive abilities seem inadequate has steadily increased It is possible that the scare of a falling birth rate has stimulated some of the recent efforts to overcome infertility but far more important has been an increasing demand for assistance from the apparently infertile themselves No longer is the wife who has failed to conceive automatically condemned as barren and the possibility of sterility in the husband is being more and more widely recognized The novelty of this situation however must be emphasized for it is only since about 1930 that attention has been paid to male infertility and even today far too many husbands believe that their ability to indulge in what to them is satisfactory sexual intercourse necessarily implies full fertility

## COITAL PRACTICE

For each partner adequate coitus has been the item mentioned last Since however it is the factor which is most commonly involved in human infertility its further consideration here may well take precedence over the other factors On page 74 in the discussion of the time relations of fecundation it was concluded that the probability of conception resulting from coitus is overwhelmingly greater when the latter occurs at the expected time of ovulation than at any other time It is therefore necessary for the couple anxious to produce children to have a fairly clear idea of this time in relation to the menstrual periods and to see that intercourse is taking place during what may be called the fertile phase Erroneous ideas of this and still more often complete ignorance of it are prevalent Previously it was stated that in the cycle averaging 28 days the 12th 13th and 14th days (counting the start of *the period as the first day of the new cycle) are the three most likely* days of ovulation The Mosaic law which prohibits intercourse for seven days after the period has *finished* is designed to ensure the maximum likelihood of conception in the average woman by concentrating intercourse after a fortnight s abstention during the fertile phase A few women however have relatively short cycles and long periods and in them adherence to it can be the sole cause of infertility by preventing intercourse at the right time

Many women anxious to conceive have been advised to make use of temperature records for detecting the time of ovulation and thereby indicating the right time for coitus This practice is far more likely to perpetuate the infertility than to cure it As has been mentioned the temperature record usually clearly shows that ovulation has taken place (in ovular cycles) but it seldom shows exactly when it has taken place and it *never* shows when it is going to take place Timing intercourse by means of the temperature record therefore will usually ensure that coitus occurs after ovulation and consequently too late to lead to fertilization It is not to be concluded that temperature records have no place in the investigation of infertility on the contrary they can provide most valuable information for the physician but they are of little direct use to the patient

The frequency of intercourse may have an important bearing on fertility If very occasional the chances of its coinciding with ovulation (unless timed so as to do so—which is exceptional) and therefore of resulting in fertilization are small At the other extreme if excessively

reproductive ability under careful consideration To buoy up their hopes with unwarranted optimi m for too long is scarcely desirable, but so may be the precipitation of marital rupture through the revelation of one partner s sterility In most cases, of course the couple wish to know the truth, and to be told, if such is the case, that the prospects are very limited or remote the news may be hard but should seldom be withheld No wise doctor would say that a couple could not possibly have children (unless, of course the husband had no testicles, or the wife no ovaries) nor, on the other hand could he guarantee pregnancies even though all his investigations had given normal results The most he can be ex pected to do by way of prognosis is to speak in terms of probabilities

## ESSENTIALS FOR CONCEPTION

The chapters on male and female reproductive physiology have al ready described the events leading up to and culminating in conception We may summarize this knowledge from the present point of view as follows

The male partner must produce adequate numbers of spermatozoa, which must have sufficient vitality to enable them to traverse the female reproductive tract and must then be capable of penetrating and fertiliz ing the ovum The ducts (vasa efferentia vasa deferentia and ejacu latory ducts) must not be blocked so that the spermatozoa can be ejaculated the accessory sex glands (prostate and seminal vesicles) must produce a fluid in which the spermatozoa may be ejaculated and it should be suitable both in quality (so as to permit the development of spermatozoal motility and to sustain it) and in quantity and finally the male must be able to effect proper coitus so as to deposit the spermatozoa deep within the vagina in the vicinity of the external os

The female partner must ovulate at least occasionally and must pro duce normal, fertilizable ova she must have normal uterine tubes capable of receiving ova and propelling them into the uterine cavity the endometrium must undergo adequate progestational development so as to be receptive to a fertilized egg the cervix must produce a mucus into which the husband s spermatozoa can penetrate and remain active thereafter to ascend through the remainder of the reproductive tract, and finally, the woman must be able to receive her husband so that he may penetrate deeply and ejaculate his seminal fluid close to the external os

condition called vaginismus can be overcome only in the state of flexion described above As a further aid to penetration in the dorsal position a pillow placed beneath the woman s buttocks, so as to elevate the pelvis, is sometimes useful, but perhaps a better technique is for the husband after having effected entry to hold his wife s buttocks in his hands, thereby drawing her pubis upwards towards his and ensuring the deepest penetration

To effect entry in the dorsal position the male usually requires a full erection he also has to exert considerable muscular effort simply to support a proportion of his weight If he is overweight this position is likely to be oppressive to his wife as well as unduly tiring to him. For many couples therefore an alternative position free from the above drawbacks is advisable Fortunately such a position is available is greatly to be recommended and seems to be unknown to most couples having coital problems This is the *a tergo* position, in which the wife lies on her side, again well flexed with her knees drawn up towards her chest The husband lies on his side behind and slightly below his wife facing her back and he effects entry from behind and below Provided the vaginal secretions afford sufficient lubrication—and if they do not they should always be supplemented with a suitable non greasy jelly (such as Johnson s KY jelly or Prentif lubricant)—it is quite possible to effect entry in this position with the penis completely flaccid It is therefore the position of choice in all cases of impotence due to psycho logical causes—the most common variety as will be seen later No effort is required by the husband to support his weight he lies in a position which can be retained in comfort indefinitely and he is able to effect deep penetration As an additional advantage by remaining in con nexion for some time after ejaculation the husband can prevent the outflow of seminal plasma and maintain the contact of plasma and cervical mucus thus facilitating the penetration of spermatozoa into the cervical canal

A good deal of anxiety is caused to many wives by the *fluor seminalis* mentioned above the complaint being made that after intercourse it all comes away the conclusion drawn is that something is wrong with the vagina since *it is thought the whole ejaculation must be retained if* pregnancy is to ensue Fortunately this is not the case All that must be retained is an adequate number of spermatozoa The seminal plasma from which they have departed no longer has any value and naturally enough, sooner or later trickles out of the vagina

A further error is that the wife must have an orgasm if pregnancy is

frequent the husband s fertility may be so reduced, simply because insufficient time between ejaculations is allowed to permit an adequate accumulation of spermatozoa that conception again becomes improbable An average coital frequency is 2–3 times per week, less than once a week is certainly too low, and more than 4 times a week probably too high to permit maximum fertility in most men Farris [52] has produced evidence that a minimum of five days' abstinence is required for most men to reach their maximum fertility, though highly fertile males can produce adequate ejaculates on each of three successive days

While it is true that coital efforts must take account of the probable time of ovulation if they are to succeed in producing pregnancies, it is equally true that, for many couples mechanical timing according to the physician s instructions may prove so distasteful as to interfere seriously with the proper performance of the act Some men may develop impotence when required to have intercourse on a particular day, though left to their own devices they may experience no difficulty at all A mathematical coital regime may also completely destroy libido for some women Such undesirable results must be avoided, and no couple should be persuaded to adhere to any rigid regime if an outcome of this sort seems probable

Some remarks must be made on the subject of coital positions in so far as they affect the chances of conception Since the object of intercourse from the point of view of this discussion is to ensure the deposition of an adequate number of spermatozoa in the vicinity of the external os only those coital positions which are conducive to this result can be recommended to couples anxious to reproduce Other positions may have their erotic value to some married couples and may be utilized on account of this but if conception is desired, they clearly should not be practised during the fertile phase In Western countries the so-called dorsal position is probably the most frequently used the woman lies on her back, and the man lies or kneels above her It is essential, if proper deep penetration is to occur, that the woman must have her thighs well flexed with her knees drawn up towards her chest and spread wide apart More failures result from ignorance of this necessity than from any other, but without its observance anatomical considerations alone are sufficient to prevent adequate penetration Physiological considerations are also involved since the involuntary tendency experienced by some women to contract their pelvic and perineal muscles when penetration is attempted thereby producing the

as he dare, thereby storing up unreleased sexual tension and ensuring rapid ejaculation at the next attempt The cure therefore is to avoid long periods of abstinence between each occasion of intercourse to attempt the act again as soon as possible after a failure (the same night or at any rate the next day) and for some to masturbate perhaps two or three hours before intercourse is attempted Nothing succeeds like success and a few repeated successful coital attempts usually spell the end of the condition Where penetration is difficult due attention must be paid to the coital position as previously mentioned and adequate lubrication must be provided artificially if necessary An intelligent and co operative attitude on the part of the wife is of course a great aid to success

### INVESTIGATION OF INFERTILITY THE MALE

It is still most usual for the complaint of infertility to be voiced first by the wife and for her to seek medical advice All too often this con sists in her receiving a general and pelvic examination and then being told that there is nothing wrong She may be advised to have a dilata tion and curettage and perhaps to have her tubes blown through and after this again be told there is nothing wrong It is perfectly obvious from what has already been described that this sort of investigation is totally inadequate and that to reach conclusions of any value some attention must be paid to the husband Fortunately the realization that this is true is spreading steadily both among doctors and the public and an increasing number of *couples* present themselves for advice about infertility Indeed it is becoming fairly common for husbands to seek reassurance of their fertility before their wives undergo investigation It is of course most satisfactory if husband and wife can be regarded as a unit—for such they are for purposes of reproduction—and for both to have full medical histories taken and to be given a general examina tion at the first visit The husband can then be asked to provide a seminal specimen for examination while his wife can be instructed to record her basal temperatures before returning for further investigation

For the vast majority of men ejaculation directly into a chemically clean screw-capped specimen jar by masturbation is the only recom mended procedure for obtaining seminal fluid for examination Collec tion of semen in a condom at intercourse is utterly worthless for the rubber contains substances which rapidly kill the spermatozoa and may cause them to clump together as a result no estimate of spermatozoal

to result—or even that her orgasm must coincide with that of her husband *The female orgasm, it may be stated quite categorically, plays no* physiological part whatsoever in determining or facilitating conception some women never have orgasm but can conceive without difficulty just the same Other women take much longer to reach orgasm than their husbands and so may require considerable pre- or post-coital digital manipulation so that they may achieve orgasm It may be only a small mino ity who are able to reach orgasm coincidentally with their husbands even on some let alone all occasions of intercourse Nevertheless, it is undoubtedly the duty of every husband to do the best he can by whatever activities are most acceptable to his wife to ensure that she obtains proper relief of her erotic tension on every occasion of intercourse and this as indicated above will usually require some degree of digital stimulation either before or after coitus itself Failure to effect this is very likely to result in more or less serious mental and physical ill health

A coital difficulty which may sometimes cause infertility is premature ejaculation in which the husband reaches orgasm and ejaculates either while attempting to effect entry or very soon afterwards If the latter is the case no infertility need ensue nor need any anxiety arise provided the wife can be given adequate satisfaction by other means The most sinister aspect of the condition is that it engenders a state of acute anxiety in the husband who supposes that he is sexually incompetent —*and as a result may become quite impotent,* while in an unsympathetic wife it may arouse suspicions of infidelity It is a very common condition at the start of a marriage and is to be ascribed to intense sexual excitement probably associated with long abstinence and lack of coital experience and to the difficulty ordinarily encountered in effecting entry into a virgin The popular misconception that premature ejaculation is a sign of sexual weakness must be disposed of before rational treatment can be considered In no other field of endeavour is speed and agility ever looked upon as other than a sign of strength or skill so why should rapidity in reaching orgasm be regarded in any other light? The plain fact of course is that if attempts are made to ejaculate either by masturbation or by coitus, several times in comparatively rapid succession (which may be during a day a week or more in different individuals) the time taken to reach orgasm becomes progressively longer The sufferer from premature ejaculation on the other hand is very likely to be so disappointed by his performance that instead of attempting intercourse again as soon as he can he postpones the event as long

If the seminal specimen is normal it proves that adequate numbers of viable spermatozoa are being produced and are being ejaculated satisfactorily Before the husband can be dismissed it must be proved that he can perform intercourse properly so as to permit the ejaculated spermatozoa to enter the cervical canal The post-coital test will check this, but will be described in conjunction with other investigations of the wife

If repeated seminal examination reveals inadequacy of the ejaculate what can be done to improve matters? Once again the post-coital test should be made before more elaborate investigations are undertaken since this sometimes turns out to be quite good even though the seminal fluid itself seemed to have been of poor quality Other male studies which have been advised are testicular biopsy basal metabolic rate determination estimation of F S H excretion and estimation of 17 ketosteroid excretion We may consider these separately

Testicular biopsy involves the surgical removal under anaesthesia of a small fragment of testicular tissue which is then examined microscopically after appropriate preparation It permits study of the seminiferous tubules and the interstitial cells and can show whether spermatogenesis is taking place If spermatogenesis is in abeyance the state of the germinal epithelium may indicate the possibility of its being re started by appropriate stimulation

Basal metabolic rate determination is usually made by measuring the oxygen consumption under basal conditions—that is with the subject fully at rest and fasting There is a widespread belief that if the B M R is below normal spermatogenesis may be defective—and it is further thought that subclinical hypometabolism may occur detectable only by measuring the B M R Very little acceptable evidence for either of these views has been adduced

Estimation of F S H excretion is of great value in cases of hypogonadism, for it shows whether the fault lies primarily in the testes (in which case the F S H output will be high, the pituitary being over active) or in the anterior lobe of the pituitary gland (when the F S H output is low or zero) When the hypogonadism is of testicular origin it is perfectly clear that no form of treatment can induce spermatogenesis since there is already an excess of the normal stimulating hormone from the pituitary In particular the hope of producing any effects from further stimulation with gonadotrophic hormones is obviously forlorn

Estimation of 17 ketosteroids gives a rough measure of the secretion

activity can be made, and the count of the number of spermatozoa may be quite misleading Sometimes collection of the specimen by coitus interruptus—the husband withdrawing just prior to ejaculation so as to collect the fluid in a specimen jar—is advised The acrobatic feat required to carry this out is beyond the capabilities of most men and the result is that *part of the ejaculate is lost* *This cannot be permitted* since a false impression of the seminal fluid will be obtained, not only because the volume will appear less than it really is but also because *different parts of the ejaculate contain varying densities of spermatozoa* the first few drops being practically sperm free the next portion containing most of the spermatozoa and the last part—perhaps two-thirds—being *mainly glandular secretions* and again almost free from spermatozoa Sometimes religious objections are raised to masturbation as a means of producing a seminal specimen these carry little conviction *since the* process is intended to assist medical examination and *is not for* obtaining pleasure Moreover, since all religions warmly encourage childbearing, an examination of this sort to promote fertility, cannot seriously be regarded as contrary to religion The fact is that on application being made to the priest, sanction is usually given to employ masturbation for this purpose Occasionally a husband finds himself quite unable to produce a seminal specimen by masturbation most commonly such men are subfertile as is later revealed by examination of the wife s cervical mucus after intercourse (post-coital test) Where a husband refuses to co operate by providing a seminal specimen for examination it is doubtful if the doctor is justified in subjecting the wife to any special examination other than the post-coital test unless the result of this places the husband s fertility beyond reasonable doubt

The question of the period of abstinence from intercourse which should elapse before the specimen is produced has already been discussed on page 26 Many workers advise three days as the period of abstinence because with an average coital frequency of two to three times a week this period is likely to give the most accurate impression of the husband s abilities in normal conditions Farris it will be recalled, considers that five days is more appropriate since most men do not achieve maximum fertility in less than this time

The findings on seminal examination have already been fully discussed in chapter II all that need be repeated here is that if the first specimen is not regarded as adequate two more should be tested before any definite conclusions are reached so as to eliminate the chance (which is quite considerable) of the first having been unrepresentative

vaginal surface with a medium receptive to spermatozoa it is at this time therefore that the test should be undertaken Very shortly after ovulation leucocytes reappear in the mucus which loses its ductility and becomes increasingly tacky and non receptive to spermatozoa While carrying out the test observation of the nature of the mucus itself gives additional information which is best interpreted in the light of the basal temperature record If this for example shows that ovulation has already occurred the temperature having risen from the pre ovular low level the finding of a cellular tacky mucus poorly invaded by sperma tozoa clearly has no significance but if such findings are obtained in the ovular phase faulty production of mucus may be concluded

Assuming that the test has been properly timed faulty mucus pro duction must be concluded if clear copious well invaded mucus is not found The mucus may be scanty indicating deficient cervical secretion or copious but cellular sometimes to the extent of being frankly puru lent It is then usually concluded that infection of the cervix is present but there is some doubt whether the often-diagnosed cervicitis really is due to infection *[60]* This kind of cervical dysfunction is most com monly associated with an erosion which consists of an overgrowth of the cells lining the cervical canal out over part of the vaginal surface of the cervix the endocervical tissue not being adaptable to the acid vaginal secretions becomes inflamed thus accounting for the presence of leucocytes in the mucus The mucus may appear to be perfectly normal but no spermatozoa may be present if the seminal examination is satisfactory this most probably indicates inadequate intercourse the semen not being ejaculated close to the cervix If after coital advice has been given and properly followed the same result is obtained the possi bility of failure to invade may be considered This can be tested by placing a drop of mucus on a slide with a drop of the husband s semen alongside, and covering with a cover glass The preparation can then be studied beneath the microscope and it will be seen whether the sperma tozoa can invade the mucus It is very rare for invasion to fail but cases are known where the husband s spermatozoa though unable to invade his wife s mucus can invade someone else s while his wife s mucus may be readily invaded by someone else s spermatozoa—a veritable but baffling form of marital incompatibility! In yet other cases normally appearing mucus may contain spermatozoa in good numbers but devoid of activity or showing vibrational activity only Provided intercourse has not taken place more than 16–18 hours before this suggests either deficient spermatozoal viability (which can be confirmed or excluded

of male hormone by the interstitial cells of the testis It will be remembered that a proportion of the 17 ketosteroids arises in the adrenal cortex in both men and women therefore, if no androgens are being produced by the testis the 17 ketosteroid output will be similar to that of women and since this even on the average, is not very different from that of men, the interpretation of this investigation may be difficult In general, it may be said that more information can be obtained from a clinical appraisal of the man—the extent and distribution of facial and bodily hair the pitch of his voice the extent of his muscular development and bodily proportions, and the size of his penis and scrotum—than from the estimation of his 17 ketosteroid output

It will thus be appreciated that the value of these special investigations of the male is strictly limited Further attention to this point will be paid when we come to consider the possibilities of treatment of infertility

### INVESTIGATION OF INFERTILITY THE FEMALE

The technique of recording the basal temperature and the interpretation of the records has already been discussed in chapter IV By their means the occurrence of ovulation will usually be indicated, if the records extend over several months the further information that ovulation is a regular or irregular event (even though the cycles be regular) will also be available

The post-coital test is the simplest of the special investigations though not always easy to interpret The couple are instructed to have intercourse late the night before or early on the same morning and the wife is asked not to have a bath or in any way to interfere with the vaginal contents, afterwards A sample of mucus from the cervical canal is later removed It is transferred to a microscope slide covered with a cover glass and examined directly In ideal circumstances the mucus will be clear and watery free from leucocytes (white blood cells) and teeming with vigorously active spermatozoa

The timing of the post-coital test is most important as follows from what has been said in chapter IV of the cyclical variations in the cervical mucus If carried out too early in the cycle the mucus will probably be scanty, tacky difficult to remove cellular and hostile to spermatozoa which either fail to penetrate into it or if they succeed soon lose their motility In the two or three days preceding ovulation the mucus should be copious and flow out from the external os covering the

than hinder conception Another objection is raised by the work of Brewer and Jones [17 18] who showed that the functional state of the corpus luteum is least well reflected by the appearance of the endo metrium once the period has begun and is best indicated by it a few days before the period begins Usually therefore it is best to obtain the biopsy a few days before the period begins

*When the biopsy taken at the right stage of the cycle shows a normal* secretory pattern it may be presumed that ovulation has occurred that a properly functioning corpus luteum has developed and that the endometrium has responded adequately to stimulation by progesterone secreted by the corpus luteum If ovulation has not occurred a proliferative endometrial pattern will be obtained Further confirmation of the non occurrence of ovulation should be forthcoming from the basal temperature record Abnormality of secretory development indicates either inadequate corpus luteum function or inadequate endometrial response If the same abnormal pattern is found when the test is re peated the two possible causes can be differentiated by giving some progesterone injections *during the latter half of a subsequent cycle and* taking a further biopsy if this now shows normal secretory changes it may be presumed that the reactivity of the endometrium is normal but that corpus luteum function had been inadequate It is possible that a normal endometrial biopsy may occasionally be obtained in the absence of ovulation the ovum being trapped within the follicle which under goes luteinization just the same This condition may sometimes be a *cause of unexplained infertility*

The principal pathological conditions which may be revealed by routine endometrial biopsy are *chronic inflammation of the endo* metrium and tuberculosis The true significance of the first is not clear for a recent account the reader may consult papers by Dumoulin & Hughesdon [26] and by Jackson [49] The revelation of unsuspected pelvic tuberculosis by routine endometrial biopsy is frequent enough to be important The incidence varies in different clinics and in different localities running between 1 and 5 per cent Usually no clinical sus picion of tuberculosis had previously been entertained though in some long standing slight ill health has been present

Finally we come to tests of tubal patency and function These are of two varieties insufflation and hysterosalpingography In the first of these a gas is passed into the uterus and if the tubes are open it flows out through them into the peritoneal cavity In the second a radio opaque medium is injected into the uterus and so into and through the

by seminal examination), or failure of the mucus to sustain spermatozoal activity

Biopsy of the endometrium is regarded as a routine investigation of the wife by most workers It entails removing a fragment of endometrium from the uterus after suitable preparation, the fragment is examined beneath the microscope With the majority of women it is comparatively easy to pass a biopsy curette through the cervix into the cavity of the uterus and to scrape off a fragment of endometrium with little discomfort and without any special preparation or anaesthesia Endometrial biopsy is therefore ordinarily undertaken as an out patient procedure and does not incapacitate the patient in any way Occasionally the internal os is found to be too tightly closed to permit the passage of the curette it is then usually necessary to arrange for dilatation of the internal os to be carried out under anaesthesia, when the biopsy fragment can then be obtained

Examination of the endometrial biopsy seeks to correlate the histological appearance with the stage of the menstrual cycle and to eliminate pathological conditions One of the most useful functions of the biopsy will be to show the presence of secretory changes indicating the existence of a functioning corpus luteum and therefore giving presumptive evidence of the occurrence of ovulation For this purpose the biopsy must be taken during the appropriate stage of the cycle Theoretically it would be best to take it at the height of corpus luteum activity but this may be difficult or impossible to arrange When the cycles are irregular the only practical procedure is to take it at the beginning of a period—within 18 hours of its onset Some workers advocate this as a routine since it then eliminates the risk of taking the biopsy unwittingly during the very early stage of a pregnancy (if conception has already occurred) Apart from the practical difficulties of the doctor being at the mercy of his patient s menstrual caprices other objections to this policy can be raised It is not altogether uncommon for some bleeding (usually less than in a normal period) to occur at the expected time even after conception because of this even biopsies taken at the start of a presumed period might sometimes be taken during early pregnancy The comparative frequency in fertility clinics with which biopsies are taken—with no period following because the patient has already conceived—without disturbing the existing pregnancy justifies the belief that the dangers are extremely small indeed the view has been expressed that this frequency raises the possibility that the slight trauma of taking the biopsy by stimulating decidua formation, might even promote rather

# XIII

# CAUSES AND TREATMENT OF INFERTILITY

It is probable that the most frequent causes of apparent infertility are faulty coital techniques combined with ignorance of the fertile phase of the menstrual cycle Both these matters have already been discussed but it is not amiss to reiterate their importance For instance the frequency with which ignorance of the fertile phase was encountered in a series of 372 patients attending one fertility clinic was as high as 73 per cent [81] while the common finding that women attending such clinics may have the hymen imperforate proves that complete failure of penetration is certainly one cause of infertility Sometimes coital inadequacy is due not so much to ignorance as to faulty psychology resulting in frigidity and vaginismus preventing normal intercourse Impotence which is most commonly psychogenic and premature ejaculation with which it may be associated to a greater or less extent are further causes of coital inadequacy Anatomical defects such as maldevelopment of the penis or of the vagina can have similar consequences but are relatively rare The possibility of true incompatibility between the partners of a marriage has been discussed in respect of one form—cervical hostility to the husband s spermatozoa it is probable that occasionally incompatibility may exist between the gametes themselves the husband s spermatozoa being unable to fertilize his wife s ova Conditions of this kind are known to occur in cattle

### THE MALE

Defective spermatogenesis is one of the most important groups of causes of infertility This is shown by the estimates from various clinics of the proportion of husbands so affected namely 35-68 per cent [81] In about 10 per cent of these men no spermatozoa at all are

tubes, if these are patent, X ray pictures are taken and reveal the shape *of the uterine cavity and the tubes These tests are not really alternatives,* since they give different information, some at least of which is complementary In all cases of uncertainty, therefore, it is best if both tests be applied In most clinics however because tubal insufflation is easier to carry out, it is employed first, hysterosalpingography is then reserved for special cases for those in which insufflation has not given a normal result or for those in which insufflation has given a normal result but, in spite of this, and of other factors being normal conception has still not occurred within a reasonable time Further details of these tests will be found in Appendix II

The special investigations of the female which have been described above enable the doctor to check the adequacy of coitus, the penetration of spermatozoa into the cervical mucus and their survival therein the presumptive occurrence of ovulation the adequacy of secretory development of the endometrium and the absence of endometrial disease, the functioning and patency of the tubes and the shape and position of the uterine cavity It must be emphasized that there are no means of determining the normality of the ova (other than the occurrence of conception) Sometimes it may be justified to recommend surgical opening of the abdomen (laparotomy) for direct inspection of the pelvic organs where anatomical obstructions to the passage of ova into the tubes or other conditions interfering mechanically *with conception are suspected*

THE FEMALE

There is not the slightest doubt that the commonest of the causes of infertility in the female is some defect in the cervical secretions preventing adequate penetration and survival of the spermatozoa within the mucus of the cervical canal This may be the result of under production of mucus or to the production of unsatisfactory mucus The former may be due to lack of hormonal (oestrogenic) stimulation of the endocervix Unsatisfactory mucus has too often been attributed to infection of the cervix (for which as has been stated previously only dubious evidence has been found) but it is commonly associated with erosion of the cervix This condition deserves a brief digression since some women on being told that they have a cervical erosion naturally become rather alarmed

It has been conventional to regard erosion as being evidence of infection except when found in young women with intact hymens the possibility of infection in such cases being regarded as remote these erosions have therefore been called congenital There is of course no justification whatever for such a distinction and as has already been stated the infective element has on careful bacterial examination usually been conspicuous by its absence Some form of endocrine imbalance has more recently been postulated as the cause of erosion One view is that an excess of oestrogenic stimulation or an excessive response by the glands of the endocervix results in so copious a flow of mucus over the vaginal surface of the cervix that the epithelium becomes damaged when this happens the endocervical epithelium grows over the damaged areas Another view is that the outgrowth of endocervical epithelium is itself the matter at fault perhaps being the direct result of abnormal endocrine response At all events the endocervical cells normally adapted to the alkaline environment of the cervical canal have to face the highly acid reaction of the vagina when they have grown out on to the vaginal surface of the cervix Irritation inflammation and on occasion *secondary* infection result leading to the production of hostile mucus preventing normal sperm penetration

Underdevelopment of the uterus (uterine hypoplasia) has been regarded by several writers as an important cause of infertility, It seems that the high incidence of this finding has usually been deduced from the results of clinical examination only for it is not confirmed when more exact methods—such as the passing of a sound—are used for

present in the seminal fluid This may be due to the non production of spermatozoa in the testes or to blockage of the ducts from the testes

There are many causes of failure to produce spermatozoa Mumps after the age of puberty is often accompanied by inflammation of both testicles this may be so severe as to be followed by complete atrophy, or so mild as not to be remembered but sometimes damaging to the germinal epithelium just the same The testes may suffer from direct injury or they may have been undescended at the time of puberty, even though later they may have been brought into the scrotum surgically Operations for inguinal hernia on both sides may have been followed by scarring (sometimes unavoidable) interfering with the testicular blood supply Finally there may be congenital absence or intrinsic deficiency of the germinal epithelium

Some causes of duct blockage are gonorrhoea tuberculosis and other bacterial infections causing inflammation of the epididymis and testicle and direct injury

Sometimes the cause of absence of spermatozoa is obvious from the patient s history but more often it remains obscure So it is with the less complete degrees of defective spermatogenesis Various forms of general ill health are known to cause—temporarily at least—depression of spermatogenesis influenza is notorious in this respect but within 6 weeks to 2 months the sperm count has usually returned to its previous level It seems possible that sometimes the damage to the germinal epithelium caused by such an illness is so extensive that recovery is incomplete and that many cases of seminal deficiency in otherwise normal men might be so explained Improvement in the sperm count has been seen after appendicectomy, or the removal of badly infected teeth or tonsils but it is not to be concluded that the spectre of focal sepsis should be resurrected as a common explanation Excessive smoking has sometimes been blamed and excessive sexual intercourse certainly can be a cause Men who work in very hot atmospheres—stokers bakehousemen or miners in some circumstances—may have a low sperm count which it is thought is due to the fact that spermatogenesis cannot continue unless the scrotal temperature remains below that of the rest of the body In the same way it is possible that the practice of wearing a suspensory belt continuously may be harmful to spermatogenesis Nevertheless it must be admitted that we are still largely ignorant of the causes of defective spermatogenesis

appendix—may lead to the formation of adhesions around the tubes preventing their normal functioning Sometimes inflammation of the tubes does not lead to their complete occlusion but may result in thickening of the walls with impairment of their functional capacity and with narrowing of the lumen preventing the passage of the ovum It is in tubes such as these that ectopic pregnancies are particularly likely to occur

Abnormalities of the endometrium can be a theoretical cause of infertility For example the degree of secretory development at the time of implantation of the fertilized ovum might be inadequate to permit its continued survival and growth This could be due either to insufficient secretion of progesterone by the corpus luteum (which could be discovered by studying the effect on the endometrium of added progesterone given by injection) or to an inadequate response by the endometrium to a normal level of progesterone In the former case treatment with progesterone during the latter half of each cycle might be expected to result in conception and pregnancy It is probable that cases of this kind do occur—but only infrequently It has long been supposed that this sort of defect could account for the occurrence of early abortion—so early sometimes that conception might have passed unobserved It has already been stated that Hertig and Rock in their studies of early abnormal ova destined to abort found no evidence of endometrial deficiencies whatever

The foregoing paragraphs have described some of the major causes of female infertility A number of miscellaneous causes deserve con sideration also though in this group the direct influence of these factors is uncertain to a greater or less extent Foremost in this group is the emotional aspect about which something has already been said in the section on menstrual disorders In its most glaring form this factor can produce false pregnancy (pseudocyesis) in which cyclic ovarian function is lost Various other menstrual irregularities may result from the influence of the emotions and fertility may be impaired thereby It is highly probable that the function of the tubes can be adversely affected by the same factor For a recent contribution to the study of the effect of the emotional state on fertility the reader may consult Marsh & Vollmer [70] Attention has often been directed towards the occurrence of pregnancy in women who after trying unsuccessfully for many years have adopted children in despair it is suggested that the tension of involuntary childlessness has itself been the cause of infertility and the relief of this tension by adoption has enabled the woman to become

measuring the size of the uterine cavity Many a woman believed to have a very small uterus on pelvic examination is found to admit the passage of a sound a full three inches or more In the writer s experience true uterine hypoplasia is usually associated with clear evidence of ovarian dysfunction, such as amenorrhoea or severe oligomenorrhoea which, of course, is another important cause of infertility Very rarely a minute uterus may be found in an otherwise perfectly normal woman —though scanty periods are the rule in such cases—and it becomes necessary to postulate absence of uterine response to a normal endo crine environment as the isolated anomaly

Failure of ovulation may be either invariable or intermittent Women with primary amenorrhoea due to intrinsic ovarian defect clearly suffer from irremediable infertility those whose amenorrhoea is due to in adequate secretion of gonadotrophins by the pituitary have a theoretical chance of conception if they can be made to ovulate by treatment The same applies to those women who have menstrual cycles proved by temperature records and by endometrial biopsies to be anovular It is not uncommon for women to have anovular cycles interspersed between ovular ones if the anovular cycles are only occasional, no detectable impairment of fertility may exist but if the *ovular* cycles are occasional, then clearly the chances of conception are small The same applies to women with infrequent but nevertheless ovular, cycles their problem being to ensure the coincidence of coitus with the un predictable occurrence of ovulation Occasionally ovulation may fail because the ovum remains trapped within the follicle corpus luteum development proceeds normally and a secretory endometrium is produced The ordinary methods for detecting ovulation will not dis tinguish this condition which may therefore remain an undiscovered cause of unexplained infertility

The ovum may fail to enter the Fallopian tube for a variety of reasons The fimbrial end may be sealed up or pocketed off from the ovary by adhesions There may be only one patent tube and if ovula tion occurs from the opposite ovary the chances of the ovum entering the tube are clearly small

Abnormalities of structure and function of the Fallopian tubes may prevent the meeting of spermatozoa and ova and the passage of the fertilized ova into the uterine cavity Complete blockage of the tubes may result from inflammation of the tubes (salpingitis) this condition can be due to any one of a number of infections Maldevelopment is another cause of complete blockage Peritonitis—as from a ruptured

would reduce their buffering effect on the fluctuations in blood oestrogen and so permit a return to normal menstrual function

A further form of dietary excess which may play a part in infertility has recently been described by Barton & Wiesner [*10*] who found an apparently significant association of moderate obesity with cervical hostility The latter failed to respond to measures which often prove successful in the non-obese but did respond when cane sugar (sucrose —the ordinary culinary sugar) was eliminated from the diet They have not been able to explain this surprising result

### CAUSES OF INVOLUNTARY CHILDLESSNESS AMONG THE FECUND

The causes of involuntary childlessness in fecund persons are really abnormalities of pregnancy and as such have already been described in chapter IV They together with the causes of neonatal and infantile mortality account for what may be termed reproductive wastage A most informative discussion of this subject is given in the Reports of the Biological and Medical Committee of the Royal Commission on Population [*81*] the conclusions reached being as follows

The scale in England and Wales today of reproductive wastage as a whole can only be stated as a range it probably lies between 15 and 22 per cent of all children conceived The reason for this imprecision is the lack of reliable information about the extent of abortion On this subject we have been able only to state as our own impressions (*a*) that between 9 and 16 per cent of pregnancies end in abortion and (*b*) that the share of induced abortion in the total is large though possibly less than half For the other elements in wastage exact statistics are available of all births 2 3 per cent are lost through stillbirth 2 0 per cent through neonatal death and 1 4 per cent through deaths between 4 weeks and 1 year—a total for the three of 5 7 per cent

In assessing the prospects of a reduction of wastage it is clear that induced abortion must be considered on a different footing from the other causes It must be regarded to a large extent as a method of family limitation and one way to reduce its extent would be to encourage the dissemination of knowledge about birth control This of course would not in itself lead to an increase in the number of births To reduce abortions in such a way as to increase the recruitment of the population it would be necessary to make parenthood more attractive

The reduction of the other forms of reproductive wastage depends

pregnant This may be so, but as we have no figures showing the frequency of this sequence of events it is not possible to reach any definite conclusion and probably wiser to regard it as a coincidence rather than due to cause and effect

Malnutrition and particularly dietary deficiencies, have often been cited as infertility factors but few careful studies have supported such a view [99] Indeed there cannot be the slightest doubt that some of the highest birth rates in the world are to be found in areas such as India, where nutritional standards are among the lowest It is, of course possible that the birth rate in these parts would be even higher if nutrition were better but it is quite certain that the declining birth rates of Western communities are not to be ascribed to malnutrition and that, except in rare instances infertility in women is not the result of malnutrition Actual starvation of course, is a different matter, and we have well attested evidence from the last war [*5, 94*] that in such extreme circumstances amenorrhoea and consequent sterility is the rule Such effects however, are only temporary and, with the return to normal nutrition, recovery would be expected A great deal of interest arose from the discovery that deficiency of vitamin E in the diet of rats leads to testicular damage and consequent sterility in males, and to abortion in females There have been many claims that vitamin E is of value in human male subfertility and in the prevention of abortion in women Few of these claims bear even casual examination and at present the concensus is that this substance is of no consequence either in the genesis of human infertility or its treatment

It is possible that dietary excess may be more important than moderate insufficiency in causing childlessness It is a common clinical experience to encounter menstrual irregularities in obese women, and to observe their spontaneous correction when by proper dietary control the weight is brought down Some women in this group, previously complaining of childlessness then become pregnant without further attention The exact manner in which loss of excess fat achieves this result is uncertain but a plausible explanation is as follows The oestrogens are fat soluble substances and it is therefore reasonable to suppose that there is a tendency for them to accumulate in the adipose tissue when the latter is excessive so much oestrogen might be removed from the circulating blood as to reduce the cyclic fluctuations which are fundamental to the normal menstrual rhythm In this way the proper pituitary ovarian relationship is disturbed and oligomenorrhoea or amenorrhoea follows A decrease in the extent of the fat depots

testosterone and gonadotrophin administration and so on—it is doubtful whether any of these is successful except rarely Often the nature of the testicular damage as revealed by biopsy is such that recovery is hardly probable or being confined to some tubules but sparing others is clearly not due to defective stimulation but to defective response for which no remedy is likely to be found In aspermia due to blockage of the ducts the operation in which the vas deferens is joined to the epididymis so as to short-circuit the site of blockage (vaso-epididymostomy) is sometimes performed The nature of the damage however may be such as to make this impracticable and the difficulties of preventing the opening into the vas deferens at its junction with the epididymis from becoming closed by scar tissue are very considerable Consequently except at the hands of a few experts this operation does not often succeed In our present state of relative helplessness to improve the semen of the subfertile male the most that can be done is preventive the timely treatment of undescended testicle the exercise of care in the surgical treatment of inguinal hernia so as to avoid the risk of damaging the testicular blood supply the avoidance of venereal disease or its prompt and complete treatment and the avoidance of mumps after the age of puberty But since we are largely ignorant of the cause of most male infertility even in the promulgation of preventive measures we are seriously hampered

Defective coital practice and ignorance of the fertile phase are usually amenable to treatment though some cases of impotence are very refractory For these artificial insemination (which will be discussed later) may be a practical remedy

Treatment of cervical hostility is often quite successful If the output of mucus is insufficient an increase usually follows the administration of small doses of oestrogen (not in such quantities as will inhibit ovulation of course) during the first half of the cycle Sulphonamides and antibiotic drugs are often used to overcome a supposed infective agent in the genesis of cervical hostility their effectiveness is doubtful Treatment of erosions of the cervix by electro-cautery is often effective but may have to be repeated several times before complete healing is achieved Where hostility is present even though the mucus during the ovular phase appears to be quite normal (and the spermatozoa appear to survive adequately on seminal examination) it is possible that true incompatibility exists for which little can be done A trial of the sugar-elimination regime advocated by Barton & Wiesner [*10*] would be worth while Where in spite of all efforts a satisfactory post-coital test

on progress in a number of different fields both medical and social and on the fuller application of knowledge we already possess Some saving of spontaneous abortions could be achieved if hospital facilities were more extensive and if expectant mothers could be relieved of some of their household duties and enabled to rest during the early months of pregnancy but the main need is for more knowledge and the emphasis should be on medical research The reduction of still births to a minimum requires better obstetrics and better fed and healthier mothers These are also important requirements for reducing the number of neonatal deaths but in this case better spacing of births greater facilities for the care of premature babies and the further education of mothers in the dangers of infection are also required Deaths at ages between 1 month and 1 year would be very much lower if each baby was properly fed and protected from infection by a mother who was equipped with the good health the home facilities the knowledge and the skilled counsel necessary for this task

The potential saving of children through progress along these lines can be roughly estimated at least for the losses for which we have statistics i e stillbirths and infant deaths which account for about 5½ per cent of the children born at present This loss could probably be reduced to 4 per cent the potential saving being approximately equally distributed between stillbirths neonatal deaths and death between 1 month and 1 year The saving that could be made by reducing spontaneous abortions cannot be precisely estimated but in the present state of knowledge would probably be small

Thus if we neglect the possible reaction of saving these children on the number subsequently born the addition to the rate of recruitment of the population that could result in the present state of knowledge from the reduction of reproductive wastage (apart from induced abortion) may be estimated at about 1½ per cent

### TREATMENT OF INFERTILITY

We come now to survey the prospects of increasing the chances of conception in a couple complaining of *infertility* *No attempt will be* made to describe details of the various treatments that can be used and on the whole, a somewhat pessimistic view will be taken

Defective spermatogenesis common though it be carries with it a *poor prognosis* for although numerous forms of treatment have been tried—dietary restriction or increase vitamin supplementation thyroid

ARTIFICIAL INSEMINATION

Artificial insemination can be performed either with the husband s semen obtained by masturbation (A I H) or with semen donated by another highly fertile male the donor (A I D) The moral issues raised by A I H centre solely on the propriety of obtaining specimens by masturbation and if theological considerations rate fertility as preferable to infertility artificial insemination provided it might reasonably be expected to promote fertility should logically not be prohibited simply on the grounds of its entailing masturbation At a conference on artificial insemination recently convened by the Arch bishop of Canterbury the conclusion was reached that moral objections to A I H in properly chosen cases were not valid The usefulness of A I H is quite another matter and it can be stated categorically that where adequate coitus can occur and the spermatozoa can penetrate and survive in the cervical mucus the prospects of pregnancy are greater from normal intercourse than from A I H if only because of the difficulty of timing the latter properly in relation to ovulation The indications for A I H are impotence preventing insemination (but not preventing ejaculation on masturbation) penile or vaginal defects preventing the spermatozoa from being ejaculated in the vicinity of the cervix and defects in cervical structure or function preventing the ingress and survival of spermatozoa within the cervical canal It has no value whatever in the treatment of infertility due to seminal deficiencies

A I D is intended to overcome infertility due to irremediable defects in the male such as aspermia or extreme oligospermia Its use raises serious moral and legal issues It is of course condemned by all religions as defeating one of the primary objects of marriage namely the union (achieved in fertilization) of the flesh—we should perhaps call it protein—of the two partners To many conception through the agency of another man is scarcely less odious than straightforward adultery and from the legal aspect the question of whether A I D is adulterous is an important one This issue is made more difficult by the fact that in Great Britain as in the U S A eminent legal opinions hold that the process is in fact adulterous though it is hard to see how the commonly accepted definition of adultery is to be applied to artificial insemination Adultery implies sexual intercourse though it does not require insemination or even intromission whereas in artificial insemination no intercourse is involved though insemination (not a

cannot be obtained artificial insemination may occasionally overcome the difficulty

The prospects of inducing ovulation when this function is in abeyance, are not very good They are better in younger than in older women and better when menstruation is occurring than when there is amenorrhoea When the output of F S H in the urine is excessive intrinsic ovarian failure can be diagnosed and all reasonable hope abandoned Three forms of treatment have been employed the administration of courses of oestrogen and progesterone (or a derivative) with the object of stimulating the pituitary to secrete gonadotrophins in the manner necessary to determine ovulation, the administration of gonadotrophins—usually equine serum gonadotrophin and chorionic gonadotrophin sequentially and the irradiation with X rays of the pituitary ovaries or both The writer has seen successful results from all three forms of treatment The possibility of the spontaneous resumption of ovulation must not of course be forgotten

It is not known how important an infertility factor tubal spasm may be the routine use of antispasmodics before coitus during the fertile phase in patients showing spasm has been advised by some workers but the writer has not observed any successful results The surgical treatment of tubal occlusion has its advocates but is strictly limited in its application

It has often been claimed that tubal patency tests (insufflation and salpingography) are a useful form of treatment of infertility as well as being valuable in diagnosis It is argued that many pregnancies occur within a month or two of one or other of these procedures being performed and that sometimes the long period during which previous unsuccessful attempts at conception had been made renders the chance of the conception having been independent of the procedure very small The writer does not believe that any convincing figures on this point have yet been published and the nature of the problem is such that they would be difficult to obtain Another argument is that after repeated insufflation or salpingography previously blocked tubes may be rendered patent This may indeed be true and certainly repetition of the tests is essential before a definite conclusion on the tubal status can be reached but the possibility of spasm accounting for apparent blockage is difficult to exclude so that once again the therapeutic value of the procedures remains in doubt

The possibilities of treating failure of implantation of the fertilized ovum with progesterone have already been mentioned but we have also seen that this is probably only a rare cause of infertility

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prerequisite of adultery as ordinarily understood) is However until legislation is introduced—and it is perhaps more likely to condemn than to condone the practice—participation in A I D carries with it the risk of involvement in what the courts might decide as being adultery Clearly no form of written consent could be regarded as valid or (in the case of the doctor carrying out the procedure) excul patory should that be the case A further difficulty arises over the question of the legitimacy of a child born as a result of A I D Here there appears to be no doubt whatever that such a child would be illegitimate and that to register its birth as legitimate would lay the informant open to a charge of perjury for which on conviction he could be sent to prison On the other side of the account there are marriages in which the desire for children is so great that, on the discovery of the husband s sterility A I D would be willingly under gone despite its drawbacks rather than permanent childlessness be faced For some of these couples adoption offers no satisfactory alternative and with the object of overcoming the real distress that the present system occasions moves have been made to introduce legislation to permit A I D without its present legal drawbacks and uncertainty This has been done in certain Scandinavian countries

A brief account of the technique of artificial insemination may not be out of place It may be either intracervical in which case no attempt is made to introduce seminal fluid into the uterine cavity or intrauterine when the semen is injected into the uterine cavity itself The second method overcomes the cervical barrier altogether and so theoretically is likely to be more successful but it has certain serious drawbacks In the first place seminal fluid irritates the uterus usually throwing the latter into painful spastic contractions consequently a very small quantity only (e g 0 25 ml ) of seminal fluid can be injected In the second place the danger of infection is quite serious—and might lead to sterility of the wife also by leaving her with blocked tubes Insemina tion is performed during what is expected to be the ovular phase and has to be carried out with the semen in as fresh a condition as possible —though up to three hours between ejaculation and insemination may not be excessive The cervix is exposed with a speculum the fluid is drawn up into a suitable syringe the nozzle is inserted into the cervical canal and the seminal fluid gently injected If intracervical insemination is performed the entire ejaculate can be injected though of course most of it will flow back into the vagina If intrauterine insemination is performed the nozzle of the syringe has to be passed through the

internal os (which may be difficult without first passing a sound) and only a small quantity of fluid can be injected The speculum is then withdrawn and the woman lies for some minutes with her legs close together and perhaps with her pelvis raised so as to keep the cervix in contact with the refluxed seminal fluid Many repetitions are usually necessary before conception occurs

A method of overcoming male impotence as a cause of infertility without recourse to the kind of artificial insemination described above, is self insemination by the wife To perform this, the husband produces seminal fluid by masturbation and collects it into a clean glass jar This fluid is then taken up in a special glass syringe (rather like the old fashioned ear syringe) which the wife inserts into the vagina The plunger is pushed home and seminal fluid thus arrives at the place at which normal coitus and ejaculation would have deposited it Sometimes this form of treatment cures not only the infertility but the impotence as well since the latter is usually aggravated by the husband s feelings of inadequacy engendered by his inability to make his wife conceive

# XIV

## THE CONTROL OF FERTILITY

### *FAMILY LIMITATION IN GREAT BRITAIN*

THANKS to the unique investigation carried out by the Council of the Royal College of Obstetricians and Gynaecologists [*80*] we now have a remarkable collection of data on the extent of birth control in Great Britain and its influence on human fertility during the first half of the present century Nothing like this has ever been available before and we can now consider many aspects of this problem from the standpoint of statistical probability instead of surmise

The proportion of women using birth control at some time during married life has increased considerably since the turn of the century Of those women married before 1910 only 15 per cent admitted the use of contraception the figure rose to 66 per cent for those married between 1935 and 1939 Similarly the proportion of women using birth control from the start of marriage has increased from 4 per cent for those married before 1910 to 35 per cent for those married between 1940 and 1942

The investigation obtained figures on the use of two main methods of birth control—those employing various contraceptive appliances and those not employing appliances The latter in fact consisted almost exclusively of coitus interruptus (the husband withdrawing from the vagina before ejaculation) There has been a steady growth in the use of appliance methods rising from 2 per cent of all women married before 1910 (or 16 per cent of those in this group using contraception) to 37 per cent of those married between 1935 and 1939 (or 56 per cent of those in this group using contraception) The use of non appliance methods reached a peak in the group of women married between 1920 and 1929 but has since fallen off Consideration of the data from other points of view such as the length of time during which contraceptives have been used by the various groups of women again shows clearly

the increasing prevalence of birth control methods using appliances of various sorts

When the social class of the woman is taken into account certain differences in contraceptive practice are seen For marriages before 1920 and after 1935 there is markedly more control in the richer social classes but for marriages between 1920 and 1935 there is little difference between the classes It is thought that this difference in behaviour may reflect the relative social insecurity of the manual and unskilled workers in the period between the wars Except for the group married between 1920 and 1929 the tendency is for the wealthier to adopt birth control earlier in married life for the anomalous group the behaviour of the richest and poorest was similar Regardless of the date of marriage, the proportion of women using appliance methods of contraception rises steadily with income As regards the choice of appliance methods the only difference between social classes is the considerably less common use of contraceptive vaginal tablets by the wealthier

The assessment of the effectiveness of birth control is difficult for a variety of reasons one of the most important of which is that on the whole the less fecund women either use no birth control (because they are trying to have children) or make less use of it than those of higher fecundity A measure of the effectiveness of birth control can be obtained by calculating the expected average numbers of live births when no control is used and comparing them with the actual numbers of births When this is done it appears that for the group of women married before 1910 birth control has reduced the average size of the family by 0 5 children this reduction increases steadily through the later groups until for the 1935–9 group the greater prevalence of birth control has been responsible for reducing the average size of the family by 2 7 children

An unequivocal answer can be given to the important question Does the practice of birth control affect the power to produce? Calculation of the pregnancy rates per 100 years exposure to the chance of conception gave these as 10 8 and 5 during the first 5 second 5 and third 5 years of marriage when birth control was in use Corresponding rates for women who had used birth control at some time but not in the periods under consideration were 129 50 and 24 (thus providing evidence for the effectiveness of the control) The rates for the periods when control was abandoned—with the object of becoming pregnant—were 142 114 and 52 It is clear therefore that during these periods in which contraception was given up, the fertility of these

women was actually higher than would ordinarily be expected Though we can hardly suppose that the practice of contraception for a time increases fertility once it is abandoned there can be no doubt that approved birth control methods leave fertility unimpaired when they are given up

It seems that an increasing number of women have planned the size of their families at the time of marriage but even in the group married between 1940 and 1946 only about 50 per cent of all women claimed to have done this Of those who planned the size of their families at marriage 75 per cent adopted birth control, as compared with 55 per cent of those who made no plans The average size of the family planned at marriage ranged from 2 38 children in 1910–19 to 2 08 children in 1935–39 These values showed no variation with social class an important fact confirming the view that the higher birth rates among the poor are not the result of a greater desire for children In spite of the use of birth control unwanted children were born to a proportion of women ranging between 15 and 18 per cent in the different marriage groups Not more than 5 per cent of first born children have been unwanted by these women but for second third fourth and higher orders the unwanted proportion has been much higher—60–80 per cent There was no evidence that the size of the family was better arranged by those who used appliance methods of contraception than by those who used other methods

Of all the women who had reached the menopause 45 per cent stated that they would have preferred more 9 per cent less and 43 per cent the same number of children as that to which they actually gave birth

The principal reasons given for using birth control were first, that more children could not be afforded second to space pregnancies third preservation of health and fourth that parental feelings were satisfied with the children already born Financial difficulties were advanced as a reason with about equal frequency by women with few and with many children The reasons given by those who did not use appliance methods for their use of non appliance methods were mainly dislike of experimenting and lack of knowledge Religious objections cost and difficulty of obtaining appliances were rarely mentioned

The principal reasons given by women who had never used contra ception for their non use were first that a family was wanted and that it did not matter how large it became or how quickly it grew and second that a family was wanted but did not come About 10 per cent of women gave ignorance and indifference as their reasons Religious

objections were given by 8 per cent aesthetic objections by 3 per cent and 4 per cent believed birth control to be harmful to health Women in the highest income groups gave inability to obtain a family of the desired size as the reason more frequently than those in the lower thus presenting evidence for the lesser fertility of those classes

### METHODS OF BIRTH CONTROL

We are entitled to dismiss sexual abstinence as being an unpractical birth control method We are therefore left with the two main groups to which repeated reference has already been made non appliance and appliance methods

Coitus interruptus is without doubt the most widely practised method of birth control throughout the world It goes by such other names as withdrawal or being careful In using it intercourse proceeds normally until just before the male thinks he is going to ejaculate when he withdraws the penis from the vagina and ejaculates outside it This technique has been criticized on three grounds first it is contrary to some religious ethics second it is ineffective and third it is mentally and physically harmful It would be out of place to consider the first of these any further here On the second much speculation unbacked by facts has led to its condemnation The report of the Royal College of Obstetricians and Gynaecologists has this to say The fact which will surprise many people was the *absence* of difference between the number of births to those who used appliance methods and to those who relied on non appliance methods (which as has already been pointed out implied almost exclusively coitus interruptus) In *no* marriage group whether reproduction was complete or not could any significant differences be found between the two types This also held true when we examined each social class separately On the third score however there can be no doubts at all For the male partner, the necessity to exert a continuous control over a process which ought to entail a certain degree of abandon can be most disturbing and is very likely to interfere with the proper enjoyment of the sexual act Whether it can produce prostatic engorgement and consequent disease is uncertain though in some males it has been the cause of psychogenic impotence For the woman the evil effects are more serious first, she has the constant fear that the male may fail to exert the necessary control or that even in spite of his doing so pregnancy may ensue secondly she usually fails to achieve orgasm before the male withdraws

and she may therefore be left with engorged pelvic viscera and un relieved sexual tension The common results of these are anxiety neurosis and menstrual disorders It is true that orgasm can be brought about by digital stimulation of the clitoris after the male has with drawn thereby overcoming the dangers of unrelieved sexual tension and pelvic congestion, but the fear of conception remains and cannot be lightly dismissed These grounds alone are amply sufficient to con demn the method and we have no need to appeal to its ineffectiveness or immorality

Coitus reservatus deserves a brief mention only It consists in the male prolonging coitus by avoiding orgasm but allowing female orgasm to occur Very few men are capable of doing this and the satisfaction they are likely to obtain is dubious It is possible that positive harm—through unrelieved prostatic congestion—may result from the practice which can therefore only be rejected

According to popular folklore lactation is a period during which conception cannot occur It has already been pointed out that this belief is entirely unfounded Ovulation can take place during lactation and may precede the first menstrual period following childbirth If coitus coincides with such ovulation pregnancy is just as likely to result as with ovulation at any other time

The safe period is the only other non appliance method requiring consideration It is important in so far as it is approved by the Roman Catholic Church Although some type of safe period has been advo cated for nearly two thousand years as a possible means of family limitation it is really only since the studies of Ogino [77] and Knaus [56] that serious interest in the subject has arisen It follows from what has already been said of the survival of the ovum and spermatozoa, that conception is likely to result from coitus only over a very limited period—perhaps 24–48 hours—during each menstrual cycle If inter course is avoided during this period conception should be prevented This then is the principle of the method but as the Family Planning Association booklet [29] on the subject begins There is in fact no such thing as an absolute safe period and it cannot be recommended as a method of contraception To calculate the safe period, the booklet advises the woman to keep a menstrual calendar for six months and from it to find the lengths of the longest and shortest cycles she deducts 19 from the number of days of the shortest cycle and 12 days from the longest cycle The two figures obtained by these subtractions will give the days of the cycle on and between which it

would be dangerous to have intercourse without protection The remaining days of the cycle are the safe days

The objections to the use of the safe period should now be obvious In the first place it requires more intelligence and application than most of the women in greatest need of contraceptive help can muster Secondly it requires full co operation from the husband—and all too often this will not be forthcoming Thirdly it becomes less practicable as the menstrual cycle becomes less regular for example if the cycle varies between 27 and 30 days (which is a fairly high degree of regu larity) intercourse would be forbidden between the 8th and 18th days inclusive that is 11 days per cycle but if the cycle varied between 21 and 36 days the forbidden period would extend from the 3rd to the 22nd day—20 days in all per cycle In the last example intercourse might not be allowed at all in some cycles for such unfortunate couples the safe period method would simply be an elaborate form of abstinence A further objection is that failure may result if ovulation occurs—as occasionally it may—on some altogether unexpected day of the cycle The Family Planning Association booklet states There is one further difficulty to be considered—and that is although only one egg is released each month it seems possible that on rare occasions a second egg may be produced following upon the influence of sexual emotion particularly if sexual relations have not been practised for some time Such a disturbance therefore might explain the unusual occurrence of pregnancy on a non fertile day following upon the return of the husband after say some months of absence The doubtfulness of this supposition has already received comment but it cannot alto gether be dismissed Sometimes the keeping of basal temperature records is advised as an adjunct to the use of the fertile phase provided intercourse is avoided from the start of a period until a few days after the ovular rise of temperature has occurred the risk of conception is negligible On the other hand it follows that abstinence must be practised for all but ten to twelve days per cycle

Apart from the general objections given above certain special circum stances exist in which the use of the safe period becomes entirely worthless These according to Latz [59] are as follows first after par turition or abortion until the regularity of the cycle has become re established (usually 3 to 6 months) second after serious illness or physical injury third after severe emotional upsets fourth after any drastic alteration in the ordinary routine of life such as prolonged travel in a strange climate or unaccustomed strenuous exercise

CONTRACEPTIVE APPLIANCES

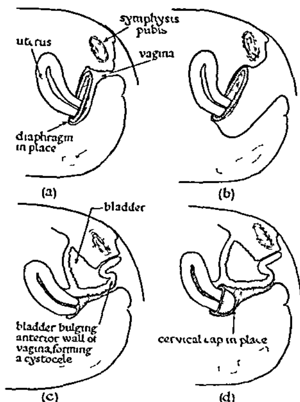
Many contraceptive appliances have been devised and they can be grouped in various ways The most practical classification is into those which can be recommended those which cannot be recommended and those which must be condemned outright There is not the slightest doubt that the ideal method of birth control has yet to be devised the large number of methods still used is evidence of this The method should be cheap to produce and to distribute, stable in extremes of climate easy to use safe and effective The ideal would be a tasteless harmless tablet which, when swallowed, would provide a period of infertility of known duration Such a substance is not yet known, but already various possibilities exist Thus Sanyal [84-89] in India has claimed that the oil obtained from green peas contains a substance which when injected into rats produces temporary sterility He has further shown that this is because it has an anti testosterone effect in the male and an anti progesterone effect in the female He has tried this substance in a small number of women with rather promising results Another substance phosphorylated hesperidin has been claimed by Sieve [91] to be an effective contraceptive when taken continuously by mouth by both husband and wife This effect, it is believed is brought about by the inhibition of the hyaluronidase produced by spermatozoa so preventing their fertilizing the ovum. Sieve reports his experience in 300 couples who had previously had one or more children and who used the method for varying periods of time up to 30 months No toxic effects were encountered and there were only two failures both in couples who admitted they had failed to take the drug properly Apparently full fertility is restored within a few days of stopping treatment

Much remains to be done but experimental work of this kind (even though the acceptability of these two studies is open to doubt) points the way to the discovery of the ideal contraceptive

We will consider now the appliance methods which can be recommended

The vaginal diaphragm, commonly called a Dutch cap is the most satisfactory form of contraceptive and when used in conjunction with a suitable spermicide is very reliable Various types of diaphragm are available and discussion of their distinguishing features is unnecessary here Briefly the diaphragm consists of a thin but strong circular dome shaped rubber membrane supported on a flexible ring which is usually

of rubber-covered metal It is placed in the vagina so that its upper part lies in the posterior fornix and its lower part just above and behind the symphysis pubis It then completely covers the cervix To be effective the diaphragm must be fitted by a doctor who uses a series of




(a) A properly fitted diaphragm in place its front end hooked behind the symphysis pubis (b) The position of the diaphragm during intercourse it completely covers the cervix (c) The presence of a cystocele makes the use of a diaphragm impossible (d) A cervical cap can be used in the presence of a cystocele

graduated rubber-covered flexible rings for assessing the correct size A properly fitted diaphragm causes no discomfort to the woman and its presence cannot be felt either by her or by her husband during intercourse If the diaphragm is too small it is liable to be pushed into the posterior fornix during coitus thereby leaving the cervix exposed

if it is too large it will not stay in place behind the symphysis pubis and so will be pushed on to the posterior wall of the vagina, again leaving the cervix exposed Certain gynaecological conditions such as prolapse of the uterus or cystocele (in which the front wall of the vagina is stretched and lax) may make the proper fitting of a diaphragm impossible and it cannot then be used Similarly, it is not practical in


(a)


(b)


(c)


(d)

The diaphragm is too small in (a) and too large in (c) During intercourse *it is likely to be displaced as in (b) and (d) leaving the cervix exposed*

newly married women who were previously *virgo intacta* because fitting is impossible until the introitus has become stretched through intercourse for a few months, while immediately after childbirth until the stretched tissues have returned to normal fitting is again impossible

Before insertion the rim of the diaphragm is coated with a suitable spermicidal jelly or cream and an additional quantity is placed in the centre of the upper surface which will come into contact with the cervix

It may be inserted at any time within two hours before intercourse and should be removed six to eight hours after intercourse A plain warm water douche may follow its withdrawal but is not necessary With proper care of the diaphragm after use—it should be washed with soap and water thoroughly dried and dusted with talcum powder —it should remain in good condition for at least a year

The satisfactory use of the diaphragm requires care and intelligence Where these are not provided or where aesthetic objections are raised alternative methods must be advised These are also required in the conditions, mentioned above which make the fitting of a diaphragm impossible

The condom or male sheath is the most extensively used of all contraceptive appliances In the Royal College survey [*80*] the incidence of the use of condoms among those who used appliance methods was 40–43 per cent in different 5-year periods of marriage By comparison diaphragms alone and in combination with chemicals were used by only 18–23 per cent of the women

Condoms are of two main varieties washable which can be used repeatedly and non washable which are discarded after use The former are stouter and more reliable than the latter but interfere more with the enjoyment of coitus Inferior brands of condom may fail as a result of the presence of pin hole defects in the rubber or through breaking during coitus The use of any greasy lubricant is highly deleterious to the rubber and most unsafe only approved non greasy lubricants of which many varieties may be purchased should be used By supplementing the barrier action of the condom with a chemical spermicide a very high degree of efficiency is attained

The use of a condom entrusts contraception to the male this may clearly be a serious drawback in some of the social classes where contraception is most desirable Its application to the penis is usually delayed until erection has occurred and therefore interrupts the smooth sequence of the sexual act at a crucial point In susceptible individuals this may introduce serious difficulties and it may be the cause of impotence It is however possible to apply the condom before sex play begins and before the penis has become erect apart from the fact that adjustment of the condom may become necessary once erection has occurred this manoeuvre may enable intercourse to proceed with out interruption

Use of the condom is most justifiable when one partner is suffering from or has recently suffered from venereal disease since considerable

protection is afforded by it Still better protection, it scarcely need be said, results from complete abstinence in such circumstances Condoms are frequently used by newly married couples but in the author s opinion this is ill advised For reasons mentioned above, and because of the tight introitus intercourse may prove unsatisfactory from the start, and psychological damage may result Complete impotence may develop and this may be difficult to overcome

The medicated tampon though less reliable than the two preceding methods still has a good deal to recommend it Cheapness com parative simplicity in use and the fact that individual fitting is not required are its chief virtues The idea apparently originated in the East where crude tampons of sea sponge cotton or rice paper saturated with vinegar were placed high in the vagina The development of this practice has led to the use of the sponge rubber tampon with an attached thread whereby it may be withdrawn after intercourse Before insertion the tampon is impregnated with a suitable chemical spermicide or foaming powder (which forms a mechanical rather than chemical barrier) it is then pushed high into the vagina so as to cover the cervix After use the tampon is withdrawn, washed and dried it can then be used repeatedly This method is suitable for use by newly married people

We now come to those methods which cannot be recommended though are not necessarily harmful

The cervical cap made of rubber metal or celluloid fits over the cervix and is held in place by suction thereby forming a mechanical barrier in the same way as a diaphragm Like the latter it has to be individually fitted If the cervix is of unsuitable shape or if it is badly lacerated or deformed the satisfactory fitting of a cap becomes im possible Moreover unless the cervix can descend (in the squatting position) so as to be within reach of the woman s fingers she will be unable to apply it or to remove it Clearly the diaphragm is easier to use Sometimes especially if not well fitted the cap may fall off the cervix without the woman being aware of such a happening By placing some spermicidal jelly within the concavity of the cap before applying it to the cervix some protection against such an accident is afforded The only condition in which the use of a cap may be advisable is where the presence of a cystocele precludes the use of a diaphragm

Chemical spermicides exist in large numbers attesting the fact that like contraceptives in general the ideal chemical agent has not yet been discovered To be effective when used alone a large number of require

ments must be fulfilled and it is safe to say that no single preparation at present on the market reaches a fully acceptable standard The more important properties which an efficient spermicide should possess are first rapid spermicidal effect in the dilution attained within the vagina and in the presence of the vaginal secretions second it should be non toxic non irritating and non-cumulative third it should pre ferably be non absorbable but if it is not it should produce no deleterious systemic action fourth no chemical change should take place while in use such as might lead to the production of a noxious substance fifth it should be a stable preparation, unaffected by climatic extremes of temperature or moisture, sixth it should be water soluble and have a low surface tension so as to spread rapidly over the surface of the cervix and vagina seventh its adhesiveness and cohesive ness should be high so that it may adhere well to both normal and abnormal mucous surfaces eighth if the active agent is insoluble in the vehicle its distribution and suspension should be and should remain uniform, ninth the viscosity of the preparation should be and should remain uniform tenth it should not be displaced easily during use eleventh it should be non staining and preferably colourless and odourless twelfth the acidity of the preparation should correspond with that of the healthy vagina (about *p*H 4 5) thirteenth the properties of the vehicle and the active principles should remain unaffected by the vaginal secretions and the seminal fluid and fourteenth it should not alter the normal bacterial population of the vagina It is hardly surprising therefore that the ideal spermicide remains to be found

Jellies creams and suppositories are the most widely used forms of chemical contraceptives The former may be applied by means of collapsible tubes attached to nozzles inserted high into the vagina or by special syringes supplied with some of the preparations The most satisfactory results are obtained by applying them on a properly fitted diaphragm Suppositories are inserted with the finger They are made of cocoa butter or gelatin and melt at the temperature of the vagina Objections to the use of cocoa butter suppositories are their greasiness leading to over lubrication of the vagina their water insolubility and to some people their odour The gelatine suppositories take a variable length of time to melt within the vagina and their degree of dispersal remains uncertain No suppositories can withstand climatic extremes at all well Other chemical preparations include foaming tablets which are intended to produce a mechanical barrier as well as to be spermi cidal and powders insufflated into the vagina by means of suitable

blowers These methods are uncertain in their use and of doubtless efficacy

One of the major drawbacks of chemical methods in general is their liability to be injurious to the user some preparations of course, suffer less in this respect than others but it is doubtful whether any substance could be devised to which some women or other did not prove to be sensitive Fortunately it is seldom that all preparations prove injurious and cases are known where vaginal inflammation caused by one chemical contraceptive has cleared up rapidly when another has been substituted

An approved chemical contraceptive inserted by means of a measured dose applicator is in the author s view, the most suitable device for the use of newly married couples before a diaphragm can be fitted Its protection is not of course absolute but the risks of failure when used for a few months only, are small and the consequences of failure should seldom be serious

Douching directly after intercourse is a method commonly advised and frequently used Various substances, some of them dangerously irritating to the vaginal epithelium are generally dissolved in the douching fluid and a number of different mechanical appliances—syringes whirling sprays douche cans and so on—are employed to deliver the fluid under pressure Douching is apt to be ineffective because as previously explained spermatozoa may ascend the cervical canal within a very short time of ejaculation and so escape the action of the douche It may be positively harmful for a variety of reasons including irritation from the dissolved substances interference with the normal bacterial population of the vagina so predisposing to invasion by abnormal bacterial which set up vaginal infection and through the use of excessive pressure forcing infected material up through the cervix, uterus and tubes leading to salpingitis or peritonitis The aesthetic objections to douching immediately after intercourse need not be emphasized while of course the longer the delay the less is the effectiveness dubious as that is even at best

Douching is often advised as a general hygienic measure following the use of other more effective methods of contraception It is however quite unnecessary an ordinary bath being entirely adequate and on the general grounds mentioned previously it is better avoided altogether except for purely medical reasons in a few circumstances

There remain for mention those contraceptive appliances which deserve outright condemnation

Stem pessaries exist in a large number of forms but all are equally objectionable They are devices inserted into the cervical canal and uterus (with a flange which remains outside the cervix to permit with drawal) where they are left for long periods They permit and encourage the ascent of infection into the uterine cavity and are frequently responsible for endometritis salpingitis and peritonitis By their pro longed irritant action they may dispose to the development of cancer They may cause perforation of the uterus There seems to be no doubt that they act by preventing implantation of the fertilized ovum as a result of the chronic inflammation of the endometrium they set up In spite of this pregnancies have been known to occur while pessaries have been in place

Grafenburg rings are no less objectionable although their inventor considered them to be an improvement on pessaries since no foreign body remains within the cervical canal The ring consists of a circular spiral silver spring and is introduced within the uterine cavity by a notched sound It is left in place for months or years and probably acts as an abortifacient That probability alone condemns it in the view of most authorities It may be responsible for uterine or tubal infection and for heavy uterine bleeding About one ring in eight it has been estimated is extruded without the patient s knowledge Finally numerous cases of pregnancy with rings *in utero* have been reported

No comment in this book is needed on abortion sterilization or X irradiation of the ovaries as methods of preventing births

# XV

# SEXUAL BEHAVIOUR AND ITS DEVELOPMENT

BECAUSE the pattern of sexual activities varies so greatly in different countries social classes and eras and because in western civiliza tions a great deal of religious prescription social taboo and legal enforcement has been applied to sex the development of clear views on the subject has been difficult The consequences have been many and serious faulty sex education leads to marital difficulties self condemna tion by individuals as abnormal mental and physical ill health and certainly sometimes the development of real instead of merely imaginary sexual disorders ignorance of the prevalence of many forms of so called sexual perversions results in cruel legal repressive measures against occasional unfortunates caught *in flagrante delicto* when in point of fact they probably differ fundamentally in their behaviour but little from the majority of their fellow humans and there has developed a widespread mentally unhealthy attitude which regards sex in any form as disgusting and not to be discussed on any plane or at the other extreme as a purely lustful activity to be indulged in secretly with individuals outside one s own social class but not to be discussed (except salaciously) within it Obviously all this is highly undesirable and socially indefensible Better knowledge of the biology of sexual activity and particularly of the actual nature and extent of sexual activities among humans of different classes and communities might go far to reorientate public opinion and so create a healthier attitude—based on knowledge instead of prejudice—towards this important subject

Quite apart from the variations in custom in different communities classes and ages objective studies the outstanding among which in recent times being those of Kinsey and his colleagues [*53 54*] have shown how wide are the variations in normal individuals These affect almost every modulus of sexual function—frequency of erections age

at first ejaculation frequency of total sexual gratification and of the various individual outlets at different ages the time taken to achieve orgasm the coital techniques used and preferred homosexual practices and so on in both sexes It is therefore imperative if narrowness and bigotry are to be avoided that the arbitrary acceptance of any given practice as abnormal should be avoided and that it should be compared with factual information if possible before a condemning conclusion is reached

It is particularly helpful in assessing the place of apparently aberrant sexual practices to view them against a background of the sexual behaviour of other animals and especially that of the apes and monkeys Extensive and careful studies on this subject are available [*15 107 108*] they throw valuable light on the development of sexual behaviour and demonstrate the widespread occurrence in nature of what among humans are arrogantly termed unnatural practices—masturbation homosexual contacts oro genital stimulation and so on As we shall see normal sexual development in the human passes through phases which entail at least some of these very practices eventually to arrive at what is generally regarded as normal adult heterosexual behaviour But we shall also see that the persistence of these practices—in apparently normal people—is far more common than some would like to believe

The plasticity of behaviour found in higher animals in contradistinction to the rigidity shown by many lower forms such as insects permits them to adapt themselves to novel situations but carries with it an enhanced likelihood of atypical behavioural development as well Animal observations amply confirm such a view thus if a kitten is reared away from the influence of other cats it may acquire the ability to chase mice as it might other moving objects but is unlikely to kill them while dogs and apes similarly reared in solitude may be found to be incapable of copulating when having reached maturity they are presented to females of their species

During its development from infancy to adulthood the child has to face a constant succession of difficult situations relying for his adaptation upon what he has already learned Reactions to adults will generally have been elaborated in his contacts with his mother and father and to other children in those with his brothers and sisters if he is fortunate enough to have them At school the first major environmental change he has to face his reaction will depend upon the home environment School offers the first opportunity to meet aggression on a large scale and if the child has been bullied at home he will very

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activity may well be pregnancy the economic factor becomes of import ance in controlling the sexual urge Hollingworth (quoted by Allen [2]) believes that the taboo on sex was established amongst primitive peoples because of the economic status of adolescence, which made it impossible to support a wife during that period With modern civilization this situation has unfortunately grown more and more acute It is more over particularly unfortunate since for males at least this period is generally that of greatest sexual capability and therefore of sexual craving A satisfactory solution to the problem seems most elusive though numerous devices some more harmful than others are utilized in grappling with it Thus masturbation and homosexual activities drain off much excess sexual energy in most adolescents while non genital heterosexual associations—such as kissing and cuddling which may lead to orgasm—are another rationalization of youth in face of the economic sanctions on copulation A great deal of misdirected effort is exerted by educational authorities to divert the sexual urges of adolescents into other non sexual channels this process called sublimation if it were effective ought to show clear cut results but these were found to be conspicuously absent in the researches of Kinsey and his colleagues [53] who concluded that sublimation was at most an academic possibility but had little existence in practical reality

Other and dangerous methods are frequently employed to inhibit the sexual desires of adolescents A boy may be made to feel that he should regard all women as sacred and therefore above all lustful thoughts that he should think of women in terms of his mother or sister and approach them accordingly Very soon it becomes obvious to such a boy that not all women wish to be treated in this way—these conse quently are regarded as bad Unless he should marry one of the bad women the difficulty of developing a normal sexual relationship with his wife if these adolescent impressions have remained is at once obvious An equally pernicious set of ideas may be inflicted on adoles cent girls by inculcating in them the belief that all men are sinister lustful and bestial the chances of a girl on whom such instruction has left a firm impression enjoying natural married relations with her husband are equally remote

PSYCHOANALYTIC THEORIES

The dominant psychological approach to sexual development is that which Freud [35] first enunciated as a result of his already extensive

*likely also be bullied at school* It is also at school that most children are initiated into frankly sexual activities Often these are homosexual involving masturbation and exhibitionism (though most children have already indulged in masturbatory activities long before school age) *sometimes childhood sexual activity may be masochistic (inflicting pain* on oneself) or sadistic (inflicting pain on others) There should be no mistake that even long before puberty heterosexual as well as homo sexual relations between children—even involving genital contacts—are *far from uncommon in civilized society as well as among more primitive* peoples (Among the latter there have been a number of careful observations such as those of Malinowski [64])

Countering this progression of developing sexual experiences is a system of inhibitions *which exist in some degree among all peoples* A child s sexual experiments with itself and with other children may be repressed either mildly or forcibly by adults—parents at first or school teachers later Infinite harm can be done by ignorant and meddlesome interference at this stage of the child s sexual development If the parental attitude is such that the child is made to feel that everything to do with sex—his own genitalia included—is dirty he is very likely to find adjustment to adult sexuality difficult or impossible and the result may be impotence or sexual perversions To punish children—girls or boys—for manipulating their genitalia is quite definitely wicked All children—without exception—indulge in masturbation to some extent to make a natural activity an object of guilt is not only absurd but raises most serious consequences in later life This of course does not imply that masturbation in public or overt sexual activity by child ren has to be permitted or condoned but there are many ways and means which will readily occur to any adult using common sense whereby these activities can be prevented from becoming excessive or from offending against the customs of our society without punishing or frightening the child or making him feel wicked Children can be taught to develop clean habits of micturition and defaecation without much difficulty and without involving fear or guilt they can be taught accept *able sexual habits in just the same way provided their parents* and teachers themselves have a sensible and healthy attitude towards these matters

A difficult period of adjustment sexually as well as socially is that of adolescence Now the instinctual sexual urges are being reinforced by the internal secretions of the gonads and are intruding themselves more and more into consciousness Because now the outcome of heterosexual

from the mental disease called manic-depressive psychosis show can nibalistic delusion which it has been suggested are derived from this source Freud supposed that the process of identification with the mother (and later the father) already mentioned arises through the fantasy of consuming the parent

The first anal stage which comes next is that during which the child finds pleasure in expelling its faeces because according to Klein by so doing it removes the fantasy of the consumed parents—a rather strained explanation to say the least But of the fact that children—and indeed adults—may obtain pleasure from defaecation there is no doubt and this may lead to the perversion of coprophilia to be mentioned in the next chapter The second anal stage is that in which the child is believed to obtain pleasure from retention of the faeces—that is when it has learned to control the activity of its bowels Psychiatrists believe that most children presenting problems of bowel control suffer from emotional disturbances which have prevented normal progression from this stage The urethral stage which corresponds with the anal stage is that in which pleasure is obtained from voiding urine

The phallic stage follows directly from the foregoing by the transference of the centre of interest from the urethra to the genital organs themselves At this stage the child begins to obtain sexual pleasure from the penis or vagina and masturbation now usually begins Abraham calls it the stage of object love with exclusion of the genitals implying that though the child obtains pleasure from his own genitalia he has no emotional interest in those belonging to the persons he loves The final genital stage is reached when libido becomes centred on the genitalia of others so that the possibility of intercourse with others now exists

The infantile sexual activities are all usually forgotten—though they may be partially recalled during the process of psychoanalysis it is very rare for anyone to remember much of them nor is it necessary for complete normality After infancy a latent period supervenes until at puberty, the endocrine activities of the gonads reawaken sexual awareness and direct sexual activities to more or less well-defined objectives In boys the ability to ejaculate and so to obtain a full orgasm greatly increases the pleasure to be obtained from sexual activity Freud believed that the role of the erogenous zones now becomes that of enhancing sexual tension this increases the desire for pleasure and so drives on the individual through the motor activity of coitus to reach orgasm and ejaculation A distinction is thus made between the fore

clinical studies of mental disease His theories, based on the psychoanalytical approach seemed so revolutionary and appeared to many to be so objectionable, that they created a good deal of hostility which has still to be fully resolved They have since been modified and extended by such workers as Abraham [*1*] and Klein [*55*]

The psychoanalytic view is that sexual behaviour dates back to the time of a child s birth The sexual aspect of emotion Freud called libido' As emotional development proceeds, different organs are held to become the centre of libidinal interest, and if development is thwarted it is possible for the major part of libido to become fixated at one of these earlier stages or, in other circumstances of emotional stress to regress to such a stage

Freud considered that three stages of sexual development are found in children and that all are normally completed before the age of 7 years In the first stage the libido is concentrated almost exclusively on the child s own body Freud therefore termed it narcissistic The second or Oedipus stage is that in which libido is centred on the mother, while hatred is felt for the father There is then a tendency for a boy to identify himself with his mother reacting in a feminine way and so his libido is essentially homosexual the successful negotiation of this stage is marked by the development of the child s ability to feel affection for his father so that now he has reached the adult stage of sexual behaviour which of course, is heterosexual Similarly on this view, a girl has to emancipate herself from excessive attachment to her father

The psychoanalysts divide the first stage into a number of further stages, depending upon the organ or activity upon which the libido becomes centred

*The first oral stage dates from birth and corresponds with suckling* from which the child derives all its pleasure this pleasure from the psychoanalytical point of view is regarded as sexual though not all psychiatrists take this attitude Kissing in adults is regarded as a relic of this phase of development

The second oral stage arrives when the teeth erupt, its main feature is eating It is supposed that whereas before this was reached all the child s emotional behaviour was erotic now aggression, and therefore hate, becomes possible Some of this hatred is thought to be turned on the parents—the mother first of all the child in its fantasy consuming the mother or at least the breast This produces feelings of guilt and ideas of retribution from the hated mother Some persons suffering

of the main conclusions reached In the sections following it will be understood that the facts are those given in the Kinsey reports

MALE SEXUAL BEHAVIOUR

The most striking features of the pre adolescent period in the male are first the extremely early age—from birth in fact—at which erotic arousal as shown by penile erection can occur secondly the ease with which erection is stimulated and thirdly the very wide range of stimuli which can achieve this result The existence of the narcissistic phase of Freud is amply substantiated Kinsey and his colleagues state

'The record suggests that the physiologic mechanism of any emo tional response (anger fright pain, etc ) may be the basic mechanism of sexual response Originally the pre adolescent boy erects indis criminately to the whole array of emotional situations whether they be sexual or non sexual in nature By his late teens the male has been so conditioned that he rarely responds to anything except a direct physical stimulation of genitalia or to psychic situations that are specifically sexual In the still older male even physical stimulation is rarely effective unless accompanied by such a psychologic atmosphere The picture is that of the psychosexual emerging from a much more generalized and basic physiologic capacity which becomes sexual, as an adult knows it through experience and condition

Pre adolescent sex play involving exhibition and manipulation of the genitalia occurs in more than half the children, mostly between the ages of 8 and 13 Cultural restrictions are chiefly responsible for limiting these activities to a level which is far lower than in the apes and monkeys Much of it is homosexual (the term is used in its wider sense)—chiefly because of the greater accessibility of the child s own sex Anal inter course is infrequent (17 per cent of those pre adolescents who have homosexual relations) and oral techniques are of similar frequency (16 per cent) The average age for beginning homosexual activities was about 9 years and 2 months that for beginning heterosexual associa tions rather earlier—8 years and 10 months Of the latter 99 per cent consists in exhibition of the genitalia 20 per cent of the boys went no further but 80 per cent indulge in manual manipulation and nearly half attempt genital union However whereas three quarters of the boys from the lower social strata attempted such pre adolescent coitus only one quarter of the boys from the group which would ultimately go to college made attempts of this kind

pleasure obtained from the erogenous zones and the end pleasure of the orgasm itself By the fore pleasure assuming the dominant aim of sexual activity—that is by persistence of the infantile type of sexuality—Freud explains many of the sexual perversions According to Jones [52] before the adult stage of sexuality is attained after puberty the individual passes through a recapitulation of his or her infantile sexual stages He supposes that where anomalies arise in the normal progression of sexual development at puberty fixations at one or other of the stages correspond with similar fixations at the stages in the infantile period Thus a youth who has difficulty in passing beyond the masturbation (auto erotic) stage at puberty is considered to have experienced similar difficulty during the infantile phallic stage

There is a growing tendency among psychiatrists to deplore the too rigid adherence to any single school of psychological theory which was a feature of former years and to recognize the potential value of each and every theory as a contribution to the fuller understanding of that most complex of phenomena the human brain We shall see that factual enquiries into the behaviour of normal individuals have failed to support the Freudian hypothesis of a pre genital stage of generalized sexual feeling It will also have been noticed that in the foregoing outline sexual development has been conceived more clearly in terms of the male than the female this is a shortcoming which reflects the fact that we know considerably less of the details of sexual development in girls than in boys This discrepancy has been reduced and our factual knowledge greatly augmented by the vast body of information in the Kinsey report [53 54] on sexual behaviour in American men and women So valuable is the factual content of these works that the attempt to summarize their main conclusions must be made Their universal validity is of course out of the question the sexual mores of different communities vary widely and it is not therefore to be supposed that the behaviour of North Americans is necessarily closely reflected by those of other countries On the other hand there are good reasons for supposing that the major tendencies revealed in this study have many applications outside the United States Some of the statistical results have proved so startling—even to the authors—that the extreme care taken to ensure their validity deserves emphasis indeed the first 156 pages out of the 730 odd pages of text in the first volume are devoted to this question and to the means necessary to obtain maximum accuracy Recent critical scrutiny has given little reason to doubt the correctness

sexual adjustments of the adolescent and adult it must be accepted as a fact that at least some and probably a high proportion of the infant and older pre adolescent males are capable of specific sexual response to the point of complete orgasm whenever a sufficient stimulation is provided [53]

In approximately 50 per cent of the men giving a history of pre adolescent sex play adolescence sees a continuation without break of sexual activities into adult life in the remainder pre adolescent sexual activities end either well before or at the onset of adolescence and a period longer in the higher than in the lower social strata intervenes before adult sexual activities commence In boys the extent of total sexual activity usually rises sharply after puberty—between the ages of 11 and 14—until within a few years the maximum rate for their whole lives is most commonly attained This as will be seen is in strong con trast to what happens in girls

Approximately 90 per cent of males ejaculate for the first time between the ages 11 and 15 the mean age for first ejaculation being 13 years 10½ months Whereas by 15 years of age 92 per cent of males have had orgasm less than a quarter of females have had such experi ence The age of first ejaculation was found to be higher in the lower social groups (14 58 years) than in the highest social group (13 71 years) these differences are thought to have a nutritional basis and to be com parable with similar differences in mean ages of menarche in females from corresponding social strata In the population studied masturba tion provided the source of the first ejaculation in two thirds nocturnal emissions and heterosexual coitus each in one eighth and homosexual intercourse in one twentieth of the men the remaining sources being very diverse and often entirely non sexual

After the initial experience in ejaculation practically all males are considered to become regular in their sexual activity this involves monthly weekly or even daily ejaculation Among 4 600 adolescent males less than 1 per cent recorded a lapse of a year or more between their first ejaculation and the adoption of a regular sex life In this respect the male differs very greatly from the female for many women undergo deprivation of sex experiences for periods from 1 to 20 years or more between their first indulgence and the adoption of regular sexual activities In the male sources of sexual outlet may change and frequencies may vary during the course of years but only rarely does sexual activity cease altogether until far into old age

Animal contacts were reported mainly by boys on farms, the fre quency of such contacts being greater between the ages of 10 and 12 than at any other period

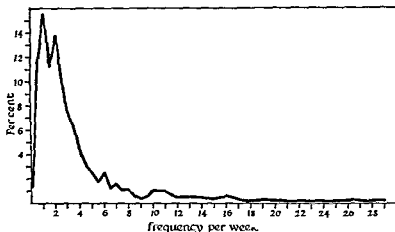
Orgasm has been known to occur in boys from as early as 5 months and is recorded in a female baby of 4 months, the observers were in no doubt of the orgastic nature of the events so recorded With advancing age, the proportion of boys able to reach the climax gradu ally increases 32 per cent up to one year 57 per cent between one and 5 years 63 per cent between 6 and 10 years and 80 per cent between 11 and 13 years But the boys providing the data for these estimations were not a representative group and it is considered that in the population as a whole a much smaller percentage of boys actually experience orgasm at an early age—because few have the opportunities to realize their capacities The observed findings however, demonstrate the extent of these capacities The speed of attainment of orgasm in pre adolescent boys varies in much the same way as in older males but the ability to have repeated orgasm within limited periods of time is greater during this period than in any other Thus, among 182 pre adolescent boys, 138 (76 per cent) reached a second climax within a short time and nearly a third could achieve 5 or more successive orgasms in quite rapid succession

The report states

These data on the sexual activities of younger males provide an important substantiation of the Freudian view of sexuality as a com ponent that is present in the human animal from earliest infancy although it gives no support to the Freudian concept of a pre genital stage of generalized activity nor does it show any necessity for a sexually latent or dormant period in the later adolescent years except as such inactivity results from parental and social repressions of the growing child It would seem that analysts have been correct in con sidering these capacities for childhood sexual development or their suppression as prime sources of adult patterns of sexual behaviour and of course many of the characteristics of the total personality There are of course, some who have questioned the truly sexual nature of the child s experiences There is a record of orgasm in 604 pre adoles cent boys The existence of such an early capacity is exactly what students of animal behaviour have reported for other mammals (Beach [11]) and it is therefore not surprising to find it in the human infant Important as learning and conditioning may be in the later development of specific types of sexual techniques and in the socio-

female, oestrogens and progesterone have rather unpredictable effects on sex drive) individual conditioning and social environment

Really low frequencies of sexual outlet are comparatively uncommon in males under 31 years frequencies of once in two weeks or less were found in only 11 2 per cent while frequencies between nought and once in 10 weeks occurred in only 2 9 per cent After the age of 35 a steady increase in the number of low rating males was found They came from all sorts of educational religious and social backgrounds but most were from the intellectually inferior group from the religiously devout group and particularly from among those males who were late in reach




Frequency of total sexual outlet for American males from adolescence to 85 years (From Kinsey Pomeroy and Martin [53])

ing adolescence Evidence of so-called sublimation wherein the libido is directed into non sexual channels was as already mentioned virtually absent

High frequencies were far more commonly encountered than the general view on the matter would lead one to expect Individuals with frequencies of seven or more per week constituted 7 6 per cent of the population They derive from all segments and classes being found among the socially prominent and the religiously devout as well as the criminal classes Boys who reach adolescence early by the age of 12 at the latest are most likely to have high frequencies in adult life Some of the individuals with high frequencies have frequent sexual contacts others belong to this group by reason of having multiple orgasm and ejaculation at each contact

*Total sexual outlet* Kinsey and his colleagues record data on six main sources of sexual outlet for the human male masturbation nocturnal emission, heterosexual petting (that is, kissing, fondling and so on not proceeding to actual coitus) heterosexual intercourse, homosexual relations and intercourse with animals of other species They have taken notice only of activities culminating in actual orgasm and ejaculation though admitting that many contacts may lead to erotic arousal short of the climax, to assess these purely subjective occurrences would clearly have been difficult

The mean frequency of total sexual outlet for 3,905 white males between adolescence and 30 years was nearly 3 ejaculations per week For the total population surveyed between adolescence and 80 years the mean was 2 74 Various considerations lead to corrected values of 3 27 and 2 34 as representative for the respective parts of the whole U S male population However, it must be emphasized that the enquiry was designed primarily to study, not averages for the whole of the United States—which mean little—but differences between social classes and age groups

The range of individual variation is of course, very wide a few males had gone for many years without ejaculating while on the other hand others had maintained average frequencies of 10–20 or more per week over equally long periods The case is quoted of a scholarly lawyer who averaged over 30 per week for 30 years These differences being several thousand fold are quite unlike those for any other biological characteristics for which differences between maximum and minimum exceeding three or four fold are rather exceptional The importance of this fact cannot be overemphasized and of course is completely overlooked by all our social organizations—laws customs educational and religious systems and so forth—which assume that individuals are much alike sexually and that it is easy for anyone to conform to the supposedly normal pattern Data on women [54] show that for them the range of variation is even greater, though more women seem to fall into the lower frequency groups

The curve of frequencies of total sexual outlet is continuous and asymmetrical It thus differs significantly from the usual 'normal distribution curve so commonly found in biology To speak of a normal or typical frequency is thus largely meaningless

The main factors responsible for the variations in frequency are thought to be age heredity hormones (of which testosterone and thyroid hormone are probably the most important in the male in the

From the legal point of view also this general unawareness of the sexual capability and actual performance of adolescent and young adult males creates a most unrealistic situation Kinsey and his colleagues calculate from their own data that at least 85 per cent of the younger male population could be convicted as sex offenders if law enforcement officials were as efficient as most people expect them to be The stray boy who is caught and brought before a court may not be different from most of his fellows but the public not knowing of the near universality of adolescent sexual activity heaps the penalty for the whole group upon the shoulders of the one boy who happens to be apprehended This situation presents a considerable dilemma for law enforcement officials and for students of the social organization as a whole

For boys confined to penal mental or other institutions the problem is even greater and the fact that the patterns of later sexual activity will be determined largely by their experiences during and shortly after adolescence is completely overlooked by the officials in charge of such institutions

The decline in sexual activity with age begins at or shortly after adolescence and in general proceeds steadily into old age Starting at the maxima of 3 2 for single and 4 8 for married males in the middle teens the mean for both groups drops smoothly to 1 8 per week at 50 years 1 3 at 60 and 0 9 at 70 In contrast to other authors Kinsey found little evidence from the frequency of sexual outlet for the existence of a male climacteric Sexual decline with ageing is due partly to a general decline in physical and physiological capacity but perhaps more to psychological fatigue that is decreasing interest in repetition of the same sort of sexual experience and decreasing desire to explore new possibilities of erotic arousal This is borne out by the decreasing numbers of sources of sexual outlet with advancing age the mean figures being 2 9 sources for older teen age males dropping to 1 6 sources by 60 years

Complete impotence in old age is by no means universal though the frequency of its occurrence increases from 27 per cent by 70 years to 55 per cent by 75 years and at 80 years three out of four white males were found to be impotent The oldest potent male in the Kinsey series was an 88 year old negro who was still having regular intercourse with his 90 year old wife

From a consideration of the age of adolescence in relation to sexual outlet Kinsey and his colleagues reach the following conclusions Males who reach adolescence earliest begin their sexual activities at once and maintain higher frequencies for the next 35 to 40 years so that,

A fact which *Kinsey and his colleagues emphasize strongly is the use* made by nearly all males of more than one source of sexual outlet most depend upon two or more and a few may make use of all six at some time or other Further *reference to this aspect will be made later*

*Age and sexual outlet* We have already seen how age affects the frequency of total sexual outlet it is in fact the most important single factor Apart from its purely biological effect on sexual ability it has the important sociological effect of influencing the source of sexual outlet through the possibility of marrying and the availability of other social contacts

There is no doubt that the maximum frequencies of sexual outlet are found in the teens The mean maximum frequency for single males was found to be 3 4 per week reached between adolescence and 20 years For married males the mean maximum is 4 8 per week between 16 and 20 years Although as stated earlier the peak capacity is probably in the late pre adolescent boy the peak of actual performance is in the *middle or later teens*

These conclusions are completely at variance with the commonly held view that sexual ability develops gradually in the male to reach a peak between 30 and 40 years and to drop abruptly after the male climacteric into the impotence of old age This pattern of gradual development however is as we shall see typical of female sexuality from which the alleged male pattern had been falsely deduced by analogy

It is obvious that profound problems are created by the failure of our social organizations to take account of the true pattern of developing male sexuality in adolescence and early adulthood The situation is still further complicated by the fact that the average adolescent girl requires about one fifth the sexual activity of the adolescent boy the *frequency of sexual outlet for the female in the twenties and thirties still* being below that of the average adolescent male Our social conventions tacitly assume that most males are sexually continent until marriage since the average unmarried American (and probably European) male has a frequency of sexual outlet of 3 4 per week it is very clear that these conventions are mere pious beliefs As to the sources of outlet for these males nocturnal emissions provide only a very small proportion masturbation a large part for the *socially and intellectually superior* minority but for the less educated 85 per cent of the American population who still regard masturbation as immoral and abnormal *pre marital intercourse* provides the major part of the sexual activity

the case of nocturnal emissions and heterosexual petting On the other hand the pattern is reversed for premarital intercourse intercourse with prostitutes and homosexual intercourse There is no doubt that the poorer classes in the United States tend to view all sexual activities other than those involving direct coitus as more or less perverted (homosexual activities are perhaps an exception) the more wealthy groups however have a much higher regard for virginity particularly in the female, but also to a considerable extent in the male so that in these classes coitus is largely avoided before marriage and other out lets principally masturbation and heterosexual activities falling short of coitus are substituted In the different educational and occupational classes the frequency of marital intercourse is more constant than is any other form of sexual outlet

Differences in attitude to various aspects of sexual technique corre spond in a general way to what might be expected from the foregoing data on frequencies of outlet in the various social classes The upper level male is sexually aroused by a far wider range of stimuli than affect the lower level male for whom little other than actual coitus has much erotic value This may be accounted for partly by the fact that in general the latter has from the age of adolescence onwards more coitus and perhaps more nearly as much coitus as he wants but it is probably also partly due to the greater imaginative capacity of the former This aspect is confirmed by the upper level male s far greater erotic valuation of nudity manual and oral manipulation as part of more highly elaborated pre-coital activity and wide variability of actual coital techniques

*Stability of sexual patterns* Many people have supposed that sexual behaviour has changed considerably within recent generations—and naturally the change is often regarded as having been for the worse To gain information on this point Kinsey and his colleagues have analysed their data so as to compare the histories of all those males of 33 years or older with those younger than 33 The median ages for the two more or less equal groups were 43 1 and 21 2 years It became apparent that the differences between these two groups were much smaller than some opinion would have led one to expect

The frequencies of total outlet for males in the higher educational groups are almost identical for both generations Among males of lower educational status these frequencies are higher for the younger genera tion The only difference between the two generations in respect of masturbation is its greater frequency among the poorer classes in the

presumably, the factors which determine the early adolescence continue to operate during this long period There is no evidence that the exercise of the sexual capacities in any way impairs those capacities (The possibility of temporary impairment of fertility by too frequent ejaculation is another matter which has already been discussed ) Those males who become adolescent late usually delay the start of their sexual activities and retain low frequencies both in early and later years Clearly if any of these individuals had deliberately chosen low frequencies at first in order to conserve their energies for later use they cannot subsequently have found sufficient justification for such use It is more probable however that they were never capable of higher frequencies of outlet

In general boys with the earliest adolescence are those who most often masturbate but they also engage in premarital intercourse, both hetero and homosexual more frequently than boys who mature late In other words they have a greater general sexual drive It seems that they are also in the main more alert energetic and socially extroverted but since human behaviour is always the product of many factors it is not surprising that exceptions to this general rule are encountered

*Social level and sexual outlet* Very striking differences in the patterns of male sexual behaviour are found at different social levels even within small communities Such levels are of course difficult to define, and cannot be expressed simply in terms of educational standard monetary income or type of occupation but rather by a synthesis of all these and other kindred considerations Practical requirements have led Kinsey to adopt a dual classification involving three grades of educational level (depending upon the number of years of education) and seven grades of occupation

The extent of total sexual outlet is greatest for the middle educational grade and least for the highest grade In the case of occupational grading however the lowest frequencies are found among the class which includes skilled mechanics this is the most unstable of all occupational classes and from it a considerable number ascend to wealthier classes The highest frequencies are found among those in the semi skilled class In general, the white-collar groups have low frequencies but the professional segment has frequencies which are among the highest of all classes

Masturbation occurs in highest frequency among the best educated and in the upper occupational classes a similar distribution is seen in

able but otherwise make use of homosexual activities as sources of sexual outlet without being particularly concerned with theoretical implications The absolute frequencies of animal contacts are low for all males but distinctly higher among the rural population as one would expect merely on the grounds of greater availability

### HOMOSEXUALITY IN MEN

By homosexual behaviour Kinsey means any activities involving the joint participation of two members of the same sex and leading to or being intended to lead to orgasm Much confusion has been caused by writers to whom the term homosexual has all sorts of restricted con notations based upon preconceived ideas rather than factual data The report shows how previous estimates of the incidence of homosexuality are largely unreliable being determined either by mere conjecture or by sampling methods which all statisticians would reject. Most of these estimates regarded the incidence as 2 or 3 per cent though a few dis sident voices considered the true figure to be nearer 100 per cent The data obtained by Kinsey relate to men who, according to the above mentioned definition have at any time had physical contacts with other males and who were brought to orgasm as a result of such con tacts they do not describe the number of persons who are homosexual in the loose popular and misleading use of the term

Their data have led Kinsey and his colleagues to conclude that at least 37 per cent of the male population of the United States has some homosexual experience between adolescence and old age They can see no reason for supposing the incidence in comparable populations in other parts of the world to be very materially different Some of course of the men so included may have no more than a single experience while at the other extreme some men have no sexual experiences other than homosexual So unexpectedly high was this incidence that to check its validity data on the matter were collected in twelve different ways but all gave substantially similar results the only remaining doubt being that the true incidence may well be higher than 37 per cent

The incidence of homosexual experience is highest among the group of males who go to secondary ( high ) school but not beyond it included 55 per cent of such males The proportion among males who went only to primary schools was 45 per cent and among those who went to universities it was 40 per cent Among single males throughout the population the incidence was about 27 per cent between the ages of

younger group For nocturnal emissions no differences were found Premarital intercourse has increased in frequency among the younger males from the lower educational groups only Intercourse with prostitutes on the other hand has decreased considerably in all the educational groups of the younger generation Almost no change has taken place in the frequency of homosexual activities and the same is true for marital intercourse Extra marital intercourse however was much more frequent in the older generation among the higher educational class but is more frequent in the younger generation among the lower educational group

The general conclusion to be drawn is that changes in sexual patterns during a period of some 22 years in the United States have been remarkably few have tended to reduce the differences between educational grades and have markedly reduced the frequency of intercourse with prostitutes As is so commonly the case in sexual matters widely accepted views are quite wrong in their censorious beliefs the true facts point if anything to improved' sexual morals rather than the opposite

Movements of individuals from one social or occupational group to another may or may not lead to changes in the expected sexual pattern If the break from the parental social level occurs early enough in life —generally not later than during adolescence—it is usual for the man to assume the sexual pattern of the class into which he has moved or will move but if the break occurs later in life he usually retains the pattern of the class from which he came It is clear, then that sexual patterns tend to be laid down before and during the period of adolescence and then to become remarkably fixed

*Rural urban background and sexual outlet* The differences in frequencies of sexual outlet for men from cities compared with those from the country are not very great, but all lie in the direction of slightly decreased sexual activity among the latter They are most marked in the lower educational level Masturbation and nocturnal emissions occur with equal frequency in both groups Heterosexual petting is decidedly more frequent among urban than among rural males The difference between the two groups is still greater in the case of premarital intercourse this is particularly true of premarital intercourse with prostitutes, which is far commoner among urban males Marital intercourse and homosexual relations occur slightly more frequently among the urban males there are however many rural males particularly in isolated parts who have heterosexual relations when women are avail

homosexual experience after adolescence 50 per cent have neither overt nor psychic experience 13 per cent react erotically to other males but have no overt experience 30 per cent of all males have at least incidental homosexual experience or psychic reactions (i e rate 1 to 6 on the scale) 25 per cent rate 2 to 6 18 per cent rate 3 to 6 having at least as much homosexual as heterosexual experience 13 per cent rate 4 to 6 10 per cent rate 5 to 6 and 8 per cent are exclusively homosexual (i e rate 6) for at least 3 years between the ages of 16 and 55 and 4 per cent of the white males were exclusively homosexual throughout their lives after the age of adolescence

It is important that though this form of assessment has profound biological significance the social significance of an individual s sexual history need have no relation to his rating on the scale It is for example possible for an older man who has never previously had a homosexual contact to force a sexual relation with a boy and although he would still only rate 1 he might if apprehended so have offended social feelings as to be sent to prison for a long term Most persons who rate 1 on the contrary have never caused offence through their sexual activities At the opposite end of the scale many exclusively homosexual males so confine their overt activities that no social problems are raised though other individuals of a similar rating may be in constant trouble through continually affronting social conventions

The high incidence of homosexual activities revealed by the studies of Kinsey and his colleagues will surprise many but it must be remembered that in several cultures other than our present one the extent of such activities has never been doubted Ancient Greece is a case in point The fact that the extent of the practice is so great in face of its strong condemnation by organized social opinion and vicious repression by the law (which merely follows biblical precept) nevertheless strongly suggests that in the absence of these restraints many more individuals would be involved It becomes clear that the concept of homosexuality as a perverse psychopathic trait is a completely unwarrantable generalization It may be argued that many males engaged in overt homosexual activities show psychoneurotic maladjustments so do many who have exclusively heterosexual contacts while of course those in the homosexual group who are emotionally well adjusted never enter the ambit of the psychiatrist who naturally sees a selected and therefore biased segment of the whole population

adolescence and 15 years, rising to about 33 per cent in the later teens but dropping consistently between 21 and 25 years The figures rise to 39 per cent for older unmarried males The drop in the early twenties is believed to be significant and to be accounted for first, because many individuals at that age try to stop their homosexual, somewhat immature activities and to conform with the demands of society for exclusively heterosexual behaviour, and secondly, because during that period the heterosexually orientated males are marrying in increasing numbers and so leaving an increasingly selected group at older ages in the single population

Homosexual activities were encountered more frequently in men who had had early adolescence than in those who matured late, these findings are consonant with the former group s more extensive overall sexual activities and are evidently a reflexion of the greater sex drive which this group shows Homosexual contacts are more frequent in urban than in rural communities and in the less religiously devout Comparison of two generations showed no difference in the incidence of homosexual behaviour

The actual frequency with which males obtain orgasm through homosexual contacts is never high, even when the calculations are confined to those males who are currently engaged in such activities Many factors account for this the activity is socially taboo and carries with it the risk of severe penalties few men even with distinct homosexual inclinations realize how many opportunities actually exist for their practice repeated relations with a single individual are very unusual while most experienced homosexuals develop extraordinary preferences for the partners they choose and not a few males with predominantly or even exclusively homosexual psychic responses refrain completely from overt activities for moral reasons or for fear of the social consequences

There is a widespread belief that individuals can be divided neatly into heterosexual and homosexual categories the latter showing clear cut distinguishing physical and mental attributes The data obtained by Kinsey confirm other studies in showing this to be completely untrue every gradation exists (as any student of biology should have expected) between the exclusively heterosexual and the exclusively homosexual the latter at least representing an unusual extreme variant Kinsey and his colleagues devised a heterosexual homosexual rating scale of seven grades (0–6) into which an individual is fitted on the basis of his overt experiences and psychic responses Using this method of assessing the population they found that 63 per cent of all males have no overt

figure of 86 per cent quoted above among the adolescent boys masturba tion appears to have accounted for only 68 per cent of first orgasms

It is thus clear that during their pre adolescent sexual contacts with boys or with other girls many girls had acquired their first information about sex including some knowledge of the male and female genitalia and sometimes about reproduction as well as of masturbatory coital and other techniques Much of the information so acquired represents a part of the necessary knowledge which many parents carefully avoid giving their daughters at any age A significant proportion of the girls had discovered what it meant to be aroused erotically and moreover to be aroused to the point of orgasm so that during the pre adolescent contacts they had acquired emotional experiences preparing them for the acceptance of later sexual activities

Frequently guilt reactions had made these childhood experiences traumatic this of course was particularly true when the children had been discovered by adults and had been punished for their actions The most serious aspect of this matter is that these guilt reactions had in many instances prevented the girl from freely accepting sexual relations in her adult and married life On the other hand when parental dis covery led to no undue emotional disturbance there was little evidence that the child s experience had done any damage so far as later sexual adjustment was concerned

In contrast with the male it appears that in the female the overt sex activities of pre adolescence are only rarely carried over into those of later years These discontinuities between the pre adolescent and later activities of the female seem to be products of social customs rather than the result of any inherent differences between the sexual make up of boys and girls

As the girl approaches adolescence increasing parental restraints are commonly placed on her contacts with the opposite sex and the warn ings against relationships with a possible sexual content are increasingly stressed The cessation of pre adolescent sex play in the years approach ing adolescence was taken by Freud and his followers to represent a period of sexual latency it seems more probable however that this is merely an effect of cultural restraints On the other hand pre adolescent masturbation usually does carry over to the adolescent and adult years probably because it does not fall under the restraints which are imposed upon socio-sexual activities

Perhaps the most striking difference between males and females in their sexual development appears at puberty In the male there is a

### FEMALE SEXUAL BEHAVIOUR

In a recent well documented review of sexual behaviour in humans and other vertebrates Ford and Beach [53a] have brought together the hitherto meagre information available on sexual behaviour in women With the appearance of the volume on sexual behaviour in the human female by Kinsey Pomeroy Martin and Gebhard [54] we now have virtually as much factual information on American women as on American men The authors of this remarkable document are of course fully aware of the shortcomings of the methods they have had to use in obtaining their data and they take care to point out where the record is inadequate for the drawing of more than tentative conclusions Their analysis is based on the personally obtained histories of 5940 white females the applicability of the findings outside the United States is of course an open question

There seems to be no doubt that human females are as capable of erotic arousal from the earliest ages as are human males Kinsey reports that the full display of physiological changes typical of the responses of adults have been observed in infants of both sexes at 4 months of age, and in infants and pre adolescent children of every older age It seems equally certain that some of the sexual responses of these pre adolescent girls may terminate in sexual orgasm Some 14 per cent of all the females in their sample are reported to have reached orgasm either in masturbation or in sexual contacts with other persons prior to adolescence This is nearly half of those who had been erotically aroused before adolescence Thirteen per cent of the females recalled masturbation by the age of 10 years, at least 8 per cent had been reaching orgasm by this age Other sources of arousal or orgasm were from psychological or physical contacts with other girls (6 per cent by 13 years of age) or with boys (12 per cent by 13 years of age)

Of the 659 females in the sample who had experienced orgasm before adolescence 86 per cent had achieved it by masturbation some 7 per cent in sexual contacts with other girls 2 per cent in 'petting and 1 per cent in coitus with boys or older males Two per cent had had their first orgasm in physical contacts with dogs or cats and another 2 per cent under other entirely non sexual circumstances including climbing a rope It thus appears that orgasm is achieved in self masturbation more often by pre adolescent girls than by boys In the latter it will be recalled the first orgasms are frequently a product of physical and emotional situations without any sexual content In contrast to the

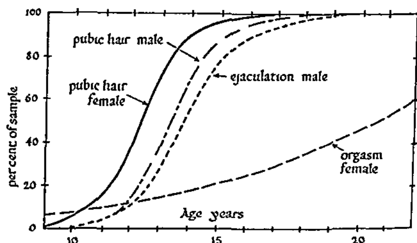
orgasm, while essentially 100 per cent of the males had at the time of their marriage long since had their first orgastic experience and had indeed already passed the peak of their sexual capacity Practically all of the males born since 1910 had had a regular sexual outlet before marriage with mean frequencies of about 2 9 orgasms per week for 10½ years Not more than 10 to 20 per cent of the females who were having any outlet from any source averaged as much as once per week for as long as 5 years before marriage Between the ages of 16 and 20 the average male was having experience of three or more different types of sexual activity while the average female in the same age period was having experience of only one At the time of marriage the mean number of orgasms which the average female and male (born after 1910) had ever had amounted to the following

| *Activity to orgasm* | *Accumulative incidence per cent to orgasm* | | *Mean number of orgasms* | |
|---|---|---|---|---|
| | *Female* | *Male* | *Female* | *Male* |
| Total outlet | 64 | 100 | 223 | 1523 |
| Masturbation | 41 | 94 | 130 | 872 |
| Nocturnal dreams | 12 | 82 | 6 | 175 |
| Petting | 37 | 26 | 37 | 64 |
| Coitus | 27 | 80 | 39 | 330 |
| Hoomsexual | 5 | 30 | 11 | 75 |
| Animal contacts | — | 8 | — | 7 |

Striking as these differences are the considerable individual variations encountered imply that for many marriages the discrepancies between male and female experience before marriage must be far greater than those for the average as quoted above It is thus not surprising that sexual maladjustments in early marriage are relatively common and may lead to divorce What is perhaps more surprising is that so many married couples do succeed in working out satisfactory sexual relationships Kinsey and his colleagues do not discuss the point but it seems that mutual love and affection combined preferably no doubt with knowledge can go far to overcome the difficulties imposed by social custom

Again in contrast with the male it appears that the educational backgrounds and the occupational classes of the parents of girls have less influence on the extent of their premarital activities than is the case

dramatic upsurge of sexual activities of all kinds at this time with the attainment, within a very short period of a peak of frequency of sexual responses carrying over from the pre adolescent years to adulthood In women, on the other hand the maximum development of these responses is not reached until the middle twenties or even the thirties Although the physical changes of adolescence appear earlier in the girl than in the boy her sexual maturation in contrast to what is commonly supposed, occurs much more slowly than that of the male She thus reaches the stage at which she is able to reproduce long before that at which she is capable of showing maximal sexual response Since however, it appears that girls are born with the anatomical and physiological




Comparison of age of adolescence and sexual response in males and females by accumulated per cents (From Kinsey Pomeroy Martin and Gebhard [54])

equipment necessary for sexual responses and may indeed be capable of showing these from the earliest ages it seems likely that the acquisition of the full capacity to respond depends very largely upon psychological conditioning and this in turn is the result of the social and emotional circumstances to which they are subjected during their pre adolescent and later years

*Total Sexual Outlet* Apart from changes with age we have to distinguish between the frequencies of sexual outlet of married and unmarried women The differences in frequencies of orgasm in unmarried females and in unmarried males are of considerable social significance They may be summarized as follows by the time they were married some 36 per cent of the females in the sample had not yet reached

a regular and frequent source of sexual activity of such an extent as to preponderate over any other kind of activity before marriage

In the four decades covered by the Kinsey survey it was found that the percentage of married women achieving orgasm in marital coitus rose steadily For example in the age group 21 to 25 some 80 per cent of women born before 1900 had reached orgasm but of those born in the four successive decades 86 90 and 92 per cent respectively so responded In contrast the frequencies of marital coitus had become reduced during the four decades but the changes were not very great

The incidences of total outlet were generally a little higher for the better educated groups but there appears to have been no correlation with the occupational class of the parents The same effects of religious feeling however as were apparent in the unmarried women also applied to the married women so that the more devout had less frequent marital sexual activity than did the less devout

Marital coitus accounted for something between 84 and 89 per cent of the total outlet of the married women in the sample between the ages of 16 and 35 After the middle thirties the importance of marital coitus decreased somewhat In the age group 46 to 60 only 73 per cent of the total number of orgasms arose from that source Masturbation was the second most important form of outlet providing something between 7 and 10 per cent of the total number of orgasms Although 11 per cent of the total outlet had come from this source after the age of 40 the increase in importance of extra marital coitus had reduced masturbation to third place in the list Extra marital coitus and orgasms derived from extra marital heterosexual contacts not involving coitus accounted for something between 3 and 13 per cent of the total outlet of the married females in the sample As mentioned above this had reached *second place as a source of outlet after the age of 40 when it provided* some 12 per cent of the total orgasms in that period Nocturnal dreams accounted for only 1 to 3 per cent of the total outlet of the married women Homosexual contacts never provided more than a fraction of 1 per cent of the orgasms of these women

The percentage of married women who never reached orgasm in any form of sexual activity was highest in the younger age groups accounting for 22 per cent of the married women between the ages of 16 and 20 and 12 per cent of married women between the ages of 21 and 25 The number of these unresponding individuals dropped steadily in successive age groups reaching 5 per cent in the late thirties

with boys The decade in which the girl was born has had a small influence the active incidences being somewhat lower for the women born before 1900 Also in contrast with the male is the fact that the age of onset of adolescence has not affected the frequency of total outlet for the girls Quite different however is the effect of religious adherence for Protestant Catholic and Jewish girls the more devout invariably had had less sexual experience than the less devout

Of the various sources of orgasm for the unmarried girls masturbation has been the most important for all ages Coitus was the second chief source in all groups after the age of 20 and for those females who were still unmarried in their late thirties and forties it was nearly as important a source of outlet as masturbation Homosexual contacts provided a rather important portion of the total outlet for the unmarried females between the ages of 26 and 40 Orgasm as a result of heterosexual contacts not involving coitus ( petting ) was an important source for the females between the ages of 16 and 30 but had become much less important after that age Orgasms as a result of nocturnal dreams never accounted for more than 2 to 4 per cent of the total outlet of the unmarried females in any age group

The existence of a large group of females not having any sexual outlet of any kind constitutes a social problem of some importance Between adolescence and 15 years of age 78 per cent and among the older teen age girls 53 per cent had not reached orgasm in any kind of sexual activity Although these percentages decline with increasing age even in the older unmarried females—over the age of 50—there were more than a quarter who had never at any time experienced orgasm Kinsey and his colleagues believe that most of these women were initially sexually responsive but had been inhibited chiefly by their moral training so that they never allowed themselves to respond to the point of orgasm A considerable proportion however were sexually wholly unresponsive and had indeed never felt the need for any kind of sexual outlet The harm which such women can unwittingly do to the sexual development of girls when they occupy positions of authority such as that of schoolteacher needs little comment

In the sample reported by Kinsey and his colleagues the median female had married at the age of 23 and by the time of marriage 97 per cent had experienced erotic arousal while 64 per cent had had at least one orgasm After marriage the frequencies of total outlet increased considerably over those of unmarried women of the same age This of course was primarily due to the fact that marital coitus now provided

a regular and frequent source of sexual activity of such an extent as to preponderate over any other kind of activity before marriage

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*Individual variation* In dealing with the male Kinsey and his colleagues were at great pains to emphasize the wide ranges of variation in all aspects of human sexual activity Their studies on the female have led them to conclude that the corresponding ranges for the female are very much greater Their record of individual variation can be briefly summarized

Two per cent of the females had never been aroused erotically Some had been aroused only once or twice or a very few times in their lives At the other extreme there were women who had been aroused almost daily and sometimes many times per day for long periods of years The same degree of tactile or psychological stimulation had brought very different responses from different females Some individuals responded with only mild physiological reactions without reaching orgasm there were others who had responded almost instantaneously to a wide variety of stimuli with intense physiological reactions quickly leading to orgasm

Among those who had *ever been aroused* there was *none* who had been totally unresponsive to tactile stimulation but there were females who appear never to have been aroused by any sort of psychological stimulus At the other extreme were women who had responded to the point of orgasm to a great variety of psychological stimuli Some of these had been more responsive to psychological stimulation than any male the authors had studied Among the women who had responded to psychological stimuli there were some who had responded only to a single sort of situation and some who had responded to every conceivable sort of situation including the observation of other persons the observation of sexual objects or activity fantasies of sexual objects or activity recall of past experience and the anticipation of new experience There was every gradation between women who had responded only occasionally to a single sort of psychological stimulus and those who had responded regularly to every possible stimulation

Instances have been reported of baby girls showing erotic responses at birth and orgasm by 4 months At the other end of the scale there were women who had not experienced their first erotic arousal until they were over 30 In addition of course there was the considerable number of women who had never experienced erotic arousal While the earliest age recorded for attaining orgasm was 4 months some 9 per cent of women in the sample had reached their late forties without achieving orgasm There were women who had reached their first orgasm at every age *between these extremes including three* who had not done so until they were between 48 and 50 years of age

Among those women who had attained orgasm there were some who had never done so more than once or twice in their lives This was true even of some of the women who had been married for many years Others had responded in 1 or 2 per cent of their marital coitus but there were many more who had responded much more often including some 40 to 50 per cent who had done so in nearly all of their coitus Some of the women had been aroused to the point of orgasm only very occasionally with lapses of weeks or of months and in some instances of years between these periods of arousal of orgasm There is a record of one woman who had gone for intervals of 28 years between periods of coitus with a masturbatory outlet of not more than one orgasm every 2 years during that long time On the other hand there were women who had responded with high frequencies and great regularity through out their lives

There were women in the sample who had responded earlier in their lives but who had ceased to experience orgasm and in some instances to be aroused erotically after their late thirties or forties More of the women however had responded until they were in their fifties or sixties and there was one case of a 90 year old women who was still responding regularly

Some of the women had derived their entire sexual outlet from a single source This source might be masturbation or heterosexual activities without coitus premarital coitus marital coitus or some homosexual contact There were a few instances of women who had never experienced orgasm except in nocturnal dreams as well as instances of married women who had never experienced orgasm except in extra marital intercourse Some of the women had in the course of their lives utilized all six of the possible sources of sexual outlet and there were others who had been continuing to utilize all six during a single 5 year period After the age of 15 something between 27 and 44 per cent of the women were depending upon a single source of outlet in each 5 year period between 16 and 33 per cent were utilizing two sources of outlet more or less simultaneously between 6 and 16 per cent three sources and a smaller proportion was utilizing four to six sources within single age periods Every conceivable combination of the possible types of sexual outlet had been encountered

The sexual history of each individual represents a unique combina tion of these variables There is little chance that such a combination has ever existed before or ever will exist again We have never found any individual who was a composite of all the averages on all of the

aspects of sexual response and overt activity which we have analysed in the present volume This is the most important fact we can report on these sexual histories of the females who have contributed to the study [54]

### HOMOSEXUALITY IN WOMEN

The precise meaning of the term homosexual as used by Kinsey and his colleagues has already been discussed It may further be remarked here that the supposition so widespread that homosexual contacts are confined to the human species is quite unrelated to the facts for sexual contacts between individuals of the same sex are known to occur in nearly every species of mammal which has been extensively studied The one particular in which human female homosexual contacts appear to differ from those encountered in sub human females is that whereas orgasm may occur in the former it does not appear to do so in the latter On the other hand it is uncertain how often females of other species ever reach orgasm in any kind of sexual activity though there are indications that in some species at least female orgasm may some times occur

In the group of females studied by Kinsey and his colleagues there were some who had been conscious of specifically erotic responses to other females when they were as young as 3 or 4 years The pro portions of those who had been so aroused rose steadily without any abrupt development to about 30 years of age by which time 25 per cent of all the females had recognized erotic responses to other females The accumulative figures finally reached a level at about 28 per cent The number of females who had made specifically sexual contacts with other females also rose gradually from the age of 10 to about 30 by which time some 17 per cent of the females had had such experience By the age of 40 19 per cent of the females had had some physical contact with other women which was deliberately and consciously at least on the part of one of the partners intended to be sexual

Female homosexual activity was largely confined to the single women and to a lesser extent previously married women who had been widowed separated or divorced It was uncommon among married women

One half to two-thirds of the women who had homosexual contacts had reached orgasm in at least some of those contacts By the age of 20 there was only 4 per cent of the total sample who had experienced

orgasm in homosexual relations and by the age of 35 still only 11 per cent with such experience The accumulative incidence finally reached 13 per cent in the middle forties

Homosexual activities like most other types of sexual activity in women (apart from marital coitus) mostly occurred sporadically There might have been several contacts within a matter of a few days and then none for several weeks or months In some there was intense and fre quently repeated activity over a short period of time with a lapse of several years before any further similar activity took place On the other hand there were a fair number of histories in which homosexual partners had lived together and maintained regular sexual relations for many years in some instances as long as 10 or 15 years or more and had had sexual contacts with considerable regularity throughout those years This situation is in contrast to that for the male where homosexual associations are only rarely on a long term basis Clearly a steady association between two females is culturally more acceptable and is in consequence a simpler matter to maintain

Even among the married women in the sample there were a few in each age group who were having homosexual contacts to the point of orgasm Some of these were completely homosexual in that they had no coitus at all with their husbands although they may have continued to live with them It is perhaps surprising to find that even in these circumstances the spouses sometimes remained on excellent terms even though their mutual sexual activities were non-existent Higher fre quencies of homosexual experience were encountered among the women who had been previously married and who were widowed separated or divorced Occasionally homosexual activities had been the cause of divorce though apparently this is very rare

Another sharp contrast between active male and female homosexuals is the high proportion of the latter who had had their experience only with a single partner This amounted to 51 per cent of the group A further 20 per cent had had it with 2 different partners 29 per cent with 3 or more and only 4 per cent with more than 10 partners Among the males on the other hand a high proportion had had it with several different persons and 22 per cent had had it with more than 10 partners

Unlike any other form of female sexual activity the incidences of homosexual activity among women correlated closely with their educa tional background They occurred among a smaller number of the women who had gone only to primary or secondary schools and in a distinctly

larger number of those who had gone to college They were found still more frequently among those women who went on to do graduate work For example at the age of 30 years 10 per cent of the primary school group 18 per cent of the secondary school group 25 per cent of the college group and 33 per cent of the graduate group had recognized that they had been erotically aroused by other females There was however little relation of the incidences to the occupational classes of the women s parents or to the decades of their birth nor was there any relation to the age of onset of adolescence Once again however homosexual activities were markedly less frequent among the religious than among the less devout women

Homosexual activity occurs less commonly among women than among men Among the former the accumulative incidences of homosexual responses had ultimately reached 28 per cent as against 50 per cent for the latter The incidences of overt contacts to the point of orgasm had been 13 per cent for the former and 37 per cent for the latter In other words homosexual responses had occurred in about half as many women as men and they had proceeded to orgasm in about a third as many women as men Furthermore there were only about a half to a third as many women in any age period who were primarily or exclusively homosexual as there were men Far fewer women had continued their homosexual activities for as many years as most of the men and a much larger proportion (71 per cent) of the women who had had homosexual contacts had restricted their activities to a single partner or to two whereas only 51 per cent of the males involved had so restricted their contacts Many of the homosexual males had been highly promiscuous sometimes finding scores or hundreds of sexual partners

Thus the widespread opinion that homosexual responses are more common among women than among men is not supported by the data obtained by Kinsey and his colleagues nor as they point out is it supported by previous studies based on specific data They suppose that the opinion may have originated in the fact that women are more openly affectionate than men in our culture Women may indulge freely in behaviour in public which in men would arouse the utmost consternation By interpreting this behaviour on the basis of male psychology men have inclined to the belief that the female behaviour reflects emotional interests that must develop sooner or later into overt sexual relationships It would appear that on the contrary most of the show of affection between women reflects no sexual interest whatever

### ORGASM IN WOMEN

Although there seems to be little doubt that orgasm is rare or even very rare among the females of sub human mammalian species in humans orgasm appears to be essentially the same in both the male and the female despite a widely held view to the contrary

Pulse and respiratory rates and blood pressure rise in the same way and there is the same increase of muscular tensions with rhythmic movements The tumescence of the penis is paralleled by that of the clitoris and the bulb of the vestibule Again contrary to the general view women appear to be capable of responding to the point of orgasm as quickly as men and indeed there are some women who respond even more rapidly than any man To respond at all however the female must be sufficiently stimulated and must not be inhibited in her activity It also appears true that women are far less susceptible than men to psychological stimuli From a close study of their case histories Kinsey and his colleagues have concluded that there must be very few if any women who are altogether incapable of response though as a result of their upbringing or later environment they may have become so inhibited as to present the picture of apparent and complete frigidity

It would appear that the average women in the sample studied by Kinsey and his colleagues had reached orgasm in something between 70 and 77 per cent of her marital coitus The percentages had varied considerably in different periods of the marriage Thus in the first year 63 per cent of coitus had result in orgasm by the fifth year the figure was 71 per cent by the tenth year 77 per cent by the fifteenth year 81 per cent and by the twentieth year 85 per cent

There were some 14 per cent of the women in the sample who had regularly responded with multiple orgasm This was true not only of the women who responded on every occasion of coitus but also of some of those who had responded to orgasm for only part of the time The woman may have had two or three or even as many as a dozen or more orgasms in a relationship in which her husband had ejaculated only once Among the younger males some 8 to 15 per cent had been capable of multiple orgasm but the capacity had decreased among the older men Since it is very uncommon for marriage to occur between men and women both capable of multiple orgasm it follows (as mentioned earlier) that for the wife to obtain her maximal satisfaction either the husband must be able to prolong coitus to a considerable

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rhythmic stimulation is more likely to lead to orgasm than other less direct though more prolonged techniques

It is highly significant that no factor showed a greater correlation with the frequency of orgasm in marital coitus than the presence or absence of premarital experience of orgasm Some 36 per cent of the women had married without having had previous experience of orgasm among them 44 per cent had failed to respond to the point of orgasm in the first year of marriage On the other hand among the women who had had even limited premarital orgastic experience only 19 per cent had failed to achieve orgasm in the first year of marriage and among those who had experienced orgasm at least 25 times before marriage only 13 per cent had failed to experience it in the first year of marriage Of the types of premarital experience leading to orgasm which cor relate most closely with the incidence of orgasm after marriage it appeared that coitus itself provided it led to orgasm was the most important Orgasm from premarital heterosexual contacts short of coitus also showed a close correlation but orgasm from masturbation appeared to be less important in determining the likelihood of a woman s attainment of orgasm after marriage In other words pre marital socio sexual contacts resulting in orgasm are most effective in paving the way to the achievement of the most satisfactory marital sexual relations for the female Clearly this fact requires serious con sideration by all who are concerned in the upbringing and welfare of girls and young women

extent or else it is necessary that other techniques, such as digital stimulation, be employed before or after actual genital union in order that the wife may be able to obtain maximal satisfaction

Many factors are involved in the determination of a woman s orgastic capacity In the first place it is clear that great variability in intrinsic capacity must exist For example the ability of a few females to reach orgasm very rapidly or to have repeated orgasms within a very short period of time may depend upon a constitutional capacity, rather than one resulting from training or any other form of experience that is it may be primarily determined genetically We have already seen that the proportion of coitus leading to orgasm increases steadily during the years of marriage The proportion of women reaching orgasm appears to have been higher in those from the upper educational levels and to a lesser extent in those coming from wealthier homes

There has also been an increase in the proportion of women achieving orgasm during the past four decades The number of women who had never responded to the point of orgasm in the first year of marriage was 33 per cent among those born before 1900 but only 22 or 23 per cent among those born after 1909 Similarly the number of women who had responded in all or nearly all their marital contacts in the first years of marriage had risen from 37 per cent in the older generation to 43 per cent in the younger It is believed that these differences are evidence of the changing attitudes and publicly accepted mores of the group to which the female belongs There is no correlation of orgastic capacity with age of onset of adolescence in contrast to the state of affairs already noted in the male The degree of religious devotion appears not to have affected the frequencies of orgasm It is perhaps of some importance that there was less infrequent response to orgasm among the females who had married by the age of 20 years than in those who married later It is probable that the greater capacity of the women marrying later depends at least to some extent upon the fact that they have had more extensive premarital experience leading to orgasm experience which stood them in good stead when they married

Contrary to what is popularly supposed the frequency of attainment of orgasm in marriage has not been closely related to the use of extensive and elaborate love techniques The data collected by Kinsey even suggest that the use of extended techniques may at least in some cases interfere with the female s attainment of orgasm Most females can masturbate to orgasm in far less time than it takes to reach orgasm in coitus It seems therefore that uninterrupted pressures or continuous

previous sections a brief review will help to give perspective to the subject This is all the more true since the boundaries of the abnormal are not all clearly marked The reader who requires detailed information is referred to Allen s [2] book on which the following account is mainly based We begin with a group of practices involving the mouth or the excretory and genital apertures

*Sexual oralism* Mouth genital contacts according to Kinsey are so common that fellatio (application of the mouth to the penis) and cunnilinctus (application of the mouth to the female genitalia) can hardly be called perversions If used as the sole form of sexual outlet they could obviously be so regarded but if mere incidentals to hetero sexual coitus they are better considered as aspects of coital technique Certainly they have their counterparts in the sexual activities of lower animals Oralism may be traced like ordinary kissing to the suck ing response—one of the earliest of all innate reactions It is un necessary to elaborate this subject further but reference must be made to a practice which has been known occasionally to lead to disastrous results namely blowing into the vagina as a variety of cunnilinctus usually on the completion of coitus At least two cases of sudden death of the woman from air embolism as a result of this activity are known to have occurred within recent years Obviously no woman aware of the risk would submit to such a procedure

*Sexual analism* is more obviously abnormal though most commonly associated with homosexuality it is not always so and may provide sexual gratification for both partners The behaviourist view of its development is that it is simply a misdirection of the sexual activity which is normally towards the vagina clearly an unsatisfying descrip tion rather than explanation The psychoanalytic view is that it is due to fixation and regression to the second stage of libidinal development where for some reason the child obtained sexual pleasure from anal contacts and tended to seek this pleasure unconsciously afterwards an explanation which is scarcely more satisfying The frequency of its occurrence is estimated by Allen as about 20 per cent of homosexual contacts but only about 0 1 per cent of heterosexual contacts Kinsey does not give precise figures

*Coprophilia and coprophagia* imply the consumption of excretions as a form of sexual pleasure usually subsidiary to the sexual act itself Psychoanalytically the perversion is regarded as a form of oral and anal eroticism the disorder is traceable back to the infant s tendency to place anything within reach in its mouth faeces included and can

# XVI

## SEXUAL ANOMALIES AND DISORDERS

In western civilization the official sexual mores if we may use such a term, are based essentially upon biblical precepts and so regard all forms of sexual activity other than genital intercourse between husband and wife as improper, those activities which do not entail coitus at all are further regarded as unnatural or perversions though it is clear from what has already been said that nearly all men and women engage in some of these activities at some time When we consider further that what is accepted sexually at one epoch in one community or at one level of a community, may be rejected elsewhere [33] it becomes obvious that this wide condemnation of *so much* sexual activity as perverted is quite irrational Many 'unnatural practices occur frequently among other animals and are therefore clearly not outside *nature Moreover it is principally among the poorer classes that* heterosexual intercourse with few or no accompaniments is in practice regarded as the only legitimate form of sexual activity at higher educa*tional levels the sophistications of sexual technique—manual and oral* stimulation by both partners coital positions other than the conventional dorsal one preference for nudity during intercourse and so on—are far more frequent But these of course are nothing more than counterparts of the *natural* activities in which lower animals indulge

There is much justification for a far broader and more tolerant view of sexual anomalies in general than has usually been adopted by our social organizations and particularly by the law Many activities usually classed under this heading occurring as frequently as they do are not usefully grouped as perversions and it is better to reserve the term for activities which really are rare and cannot be regarded as counterparts of activities in which other mammalian species commonly engage A full discussion of these anomalies of sexual behaviour clearly does not deserve a place in this book which is primarily concerned with the normal in human reproduction However as in some

plete identification of the pervert with the mother as is shown especially in those individuals who are also transvestists and must be dressed in female clothing in order to enjoy their perversion Homosexual masochism is a not uncommon variant

Feminine masochism is very different from that found in the male but is typified by the woman whose husband beats her and otherwise maltreats her but who stays with him just the same It will be recalled that in Somerset Maugham s novel *The Moon and Sixpence* on Gauguin when the latter warns the native girl who wishes to be his wife that he may beat her she replies How else will I know that you love me? indeed there is little doubt that in many communities this sort of masochistic reaction is general It can then hardly be called a perversion The harsh conditions to which women deliberately subject themselves in some convents may also be explained on masochistic lines Allen sums up the difference between erotogenic (male) and female masochism by saying that in the man masochism appears as a definite obvious outstanding neurosis which occurs periodically whereas in the woman it is more of a way of life a behaviour problem rather than a neurosis It is perhaps not clear why a neurosis is not a behaviour problem

Various psychoanalytical attempts to explain feminine masochism have been made but none is very satisfactory Undue emphasis has been placed by some writers on the girl s reaction to her discovery that she does not possess a penis and therefore directs her aggressive urges inwards towards herself Another view regards it as being a fixation on the fantasy and dream life so prolific at puberty and in which many girls show a marked masochistic element of which the rape fantasy is quite characteristic

Moral masochism Freud has regarded as farthest removed from sex It is typified by the acts of fakirs who lie on beds of nails and otherwise inflict pain on themselves for allegedly religious motives

As in sadism the compulsive obsessional element is equally shown by masochism but since the latter never involves harming other persons it does not of itself constitute a social problem

We come next to a group of perversions in which exposure of the body is important *Scoptophilia* and *exhibitionism* are a related pair one being the counterpart of the other Scoptophilia or voyeurism is the obtaining of sexual pleasure from watching other people either undressing or engaging in sexual intercourse peeping Tom is the archetype Exhibitionism is exposing oneself to obtain sexual pleasure

thus be regarded as a persistence of this behaviour Sexual interest in urine and its voiding gives rise to the perversion called undinism, in which pleasure is obtained by watching the act of urination by another person either of the same or of opposite sex A rare variant is that in which pleasure is derived from urinating upon the loved one or from being urinated upon by him or her Again the perversion unmistakably betrays the persistence of infantile behaviour

A second group is that associated with giving or feeling pain Its name *Sado masochism* is derived from the Marquis de Sade and from Sacher Masoch Sadism is defined as the obtaining of sexual pleasure from acts of cruelty, while in masochism the pleasure is derived from acts which would normally be painful or humiliating In practice some degree of admixture of the two is always found Sadism appears to shade by imperceptible degrees from straightforward cruelty to complete sexual satisfaction with orgasm and ejaculation accompanying the perpetration of the cruel act

Aggressive tendencies which are at the root of all cruelty appear very early in development though the opportunity to give expression to them scarcely arises until the development of teeth Biting the breast is thus held to be the earliest form of overt aggression the child can show and is thought by some to be the basis for later sadism The psychopathology of the condition is complicated and the subject of numerous hypotheses but little agreement It seems however that in general the sadist directs his aggressive emotions against those whom were he normal, he would love he thus transposes aggression and affection He is usually impotent or attains potency only by fantasy of the infliction of pain There is a strong element of obsessional com pulsion which drives the sadist to run great risks in order to relieve the tension—the counterpart, of course of libido in the normal person —which mounts steadily until relieved by the perpetration of the cruel act Another important fact is that frequently sadistic behaviour may appear under the influence of alcohol, in persons perhaps unaware of their liability to such a response with very serious consequences both for the victim and the perpetrator

Masochism is the inverse of the wish to hurt It can exist in three forms erotogenic feminine and moral The first is merely a reversal of active sadism and Allen considers that its mechanism proceeds from a wish to hurt the mother being converted into a wish to be hurt by the mother and hence by the same type of transference as occurs in normal development by women in general There is a partial or com

ment will now be added The psychoanalysts regard castration fear as the basis of the disorder (which description is deserved only when the individual stands high on the Kinsey heterosexual homosexual rating scale—that is has exclusively or almost exclusively homosexual relations) They consider that in boys the sight of female genitalia during infancy may raise a fear of castration—that the individual could come to resemble the female by loss of the penis—and this can persist into adulthood so that for sexual purposes all individuals who do not possess a penis are rejected The castration shock of seeing female genitalia is not itself the cause of homosexuality since under psychoanalysis many heterosexual males admit to the same shock it is the (unexplained) reaction to the shock which is abnormal in the homosexual Another possibility is for the pervert to regard the female genitalia as a castration instrument and so to express disgust for them resulting in inability to have heterosexual intercourse

Other psychopathological possibilities exist Allen believes that one of four possible situations can be causative

(1) Hostility to the mother
(2) Excessive affection for the mother } Oedipus complex
(3) Hostility to the father }
(4) Affection for the father when the father himself does not show sufficient heterosexual traits introjection of an abnormal father

In normal development affection for the mother learned during infancy later becomes transferred to other women but if such affection has never been achieved its transference will fail also and so only hatred may be felt for women Such a situation may well evoke homosexual reactions In the second possibility the father may be a non entity may die during the child s infancy or may be abroad for long periods the boy then has no masculine persons to emulate and so tends to identify himself more and more with the mother The fact that waves of homosexuality have been observed following wars is explained by this hypothesis Hostility to the father is the other side of the Oedipus triangle and may arise if the father is a brutal person who ill treats the mother once again the boy would tend to identify himself with the mother this time through hatred of the father In this type of situation all grown men are apt to be regarded as brutal like the father so that the sexual object sought is likely to be a young boy rather than an adult man Where the father is relatively effeminate

it is almost confined to males who expose their genitalia but female exhibitionists certainly do exist

The most obvious explanation of scoptophilia is that it is simply a persistence of the infantile desire to look observations of the social life of monkeys have amply demonstrated the keen interest taken by infant monkeys *in the genitalia of their mothers and in acts of coitus* by adult monkeys in the colony The data of Kinsey and his colleagues on pre adolescent sexual activities to which reference has already been made show how important a part is played by scoptophilia and exhibitionism at this stage Its presence in the adult may be looked on as a manifestation of immaturity in sexual development Its frequency among adults in a partial degree is however obvious from the considerable audiences which attend vaudeville and burlesque shows in which women appear in states of complete or partial nudity and engage in strip tease fan dances and so on

*Exhibitionism is regarded as essentially a seeking for love* but as usually carried out has a strong obsessional basis Many sufferers from it give evidence of severe repression in earlier life, so that the perversion is an act of defiance Psychoanalytical theories regard castration fears as basic to both scoptophilia and exhibitionism this may be true and is certainly easy to understand in the case of the exhibitionist whose act is perhaps a denial of castration

How completely these perversions are a product of particular social conditions is illustrated by an example of Westerbrook s (quoted by Allen [2])

If you live among men and women who are practically nude they soon fail to attract attention Everyone is attired alike it is part of everyday life Let a nude male or female garb themselves in trousers or petticoats with the rest of the people nude and one notes how soon sexual curiosity becomes excited That which is exposed never creates curiosity it is that which is hidden I recall hearing a lady missionary bound for the Bismarck Archipelago who was most distressed by the thought of leaving her husband s side before she became used to the sight of nude men and women She accustomed herself to the horrifying spectacle by peering through the portholes of the ship as it lay at anchor herself unseen

*Homosexuality* has already been dealt with from the factual point of view and we have seen that it is frequently associated with other so called perversions A few comments on the mechanism of its develop-

to produce a psychiatric cure should have prior claims over merely vindictive punishment

Two other common phenomena require consideration—masturba tion and fetishism

*Masturbation* will receive a brief mention only No proof whatever has been adduced to support the often reiterated view that it is a harm ful practice To Roman Catholics it is a carnal sin—more heinous in fact than fornication no comment on this view is necessary since it could serve no useful purpose One psychoanalytical view is that it shows attachment to the mother and is a regression to the phallic stage of sexual development if so the near universality of masturbation merely reflects the attachment which all feel to a greater or lesser degree for their mothers The harm of masturbation undoubtedly lies in the feelings of guilt which it may engender—but these can arise only through the misguided interference of adults who by their prohibitions and threats arouse such feelings So-called compulsive mastur bation and psychic masturbation (in which orgasm is reached without actual penile stimulation or other frankly erotic activities) are nearly always merely parts of overriding psychoses (such as schizophrenia) There is of course no need to approve masturbation simply because one does not condemn it If its occurrence to the usual extent in children is ignored rather than made the object of strong parental disapproval it nearly always becomes insignificant as the child s sexual development proceeds normally And in any case it may be a socially far less objectionable outlet to the intense sexual capabilities of adolescent boys at least than heterosexual intercourse which is the only natural alternative

*Fetishism* consists in the substitution for the normal sexual object of another related to it but totally unfit for the normal sexual aim A normal male may meet very many attractive women during the course of the day but not be sexually excited by any of them or perhaps by one or two These few individuals must possess some characteristic—complexion colour of hair shape of body perfume for example—which arouses the male erotically The fetishist is preoccupied solely with that characteristic and not with the woman who bears it He may *thus derive erotic stimulation from a* woman s mackintosh furs silk stockings and so forth which he may feel impelled to steal in order to excite his sexual feelings and which he may handle or contemplate while masturbating Fetishism apparently is practically confined to men

and especially if the mother proves unfaithful, the boy, by moulding himself (introjection) on the father may become homosexual in psychic response and, like his father, be hostile to women (identified with the faithless mother)

Analysis of psychic homosexuals reveals that the love object is identified with the mother (though of course, not consciously) Because of this metamorphoses of various anatomical parts of erotic interest also occurs Thus the breasts of the mother become transmuted into the penis of the sexual partner (explaining the frequent fellatio found among homosexuals) or into the buttocks (hence homosexual sadistic attacks on the buttocks, typified by the schoolmaster s canings and the homosexual s interest in men in tight breeches) and the vagina becomes symbolized by the partner s anus or mouth

Since at the time of puberty boys and girls often pass through a clearly defined homosexual stage it is a particularly vulnerable period during which seduction by homosexuals may conceivably lead to fixation at the homosexual level and so prevent normal heterosexual behaviour from developing The social importance of this cannot be overemphasized and the ease with which perverts can be placed in positions of authority over children—as school masters and mistresses scoutmasters Sunday school teachers and so on—without proper enquiry into their antecedents is alarming It is also very pertinent to mention that repeated severe jail sentences often have no deterrent effect upon such persons and therefore clearly serve no useful purpose Fortunately the judiciary is showing a growing awareness of the futility of such punitive measures and of the far better potentialities of proper psychiatric treatment

*Transvestism* the wearing of the clothes of the opposite sex for sexual purposes, is nearly always combined with other practices such as homosexuality, sado masochism exhibitionism, and fetishism Well known examples are Caligula and the Chevalier d Eon (hence *Eonism*) and George Sand

*Infantosexuality* the use of immature persons as sexual objects, we have already met with as part of other perversions It is especially associated with homosexuality Psychoanalytically it is the result of an unresolved Oedipus complex, wherein the mature female suggests the mother with whom sexual relations are prohibited children are therefore rationalized as substitutes The practice is potentially socially harmful for reasons pointed out above and is usually dealt with savagely by the law, though scarcely for the same reasons The attempt

seen a case wherein normal intercourse occurred between a man and woman before they were married but when after marriage the woman told her husband that she had previously had intercourse with other men he became impotent Conscious or unconscious psychic homo sexuality is also a cause of impotence as are certain frank psychoses such as depressive states

The psychoanalysts consider impotence and frigidity to be the result of infantile modes of reaction the main cause being unconscious hate The anxiety which commonly accompanies sexual aversion is attri buted to the castration complex—the unconscious wish to castrate the father with consequent fear that he will retaliate upon the patient This is rationalized into various causes for the sexual difficulty—causes which do not in fact bear close examination Fixations at stages other than the Oedipal—oral and anal for example—may also result in impotence The condition has been summarized as a form of focal suicide brought about to solve unconscious conflicts caused by fear of punishment reprisals and of unconscious hate associated with deficiencies in the erotic investment of the act due to conflicting aims

*Excessive sexual desire* is especially difficult to define because the normal in sexual desire is itself so variable The frequency with which a man has ejaculations is not necessarily a guide to his normality or excess of desire regular ejaculation once a day or more need not necessarily stamp a man as oversexed On the contrary the victim of satyriasis (in the male) or nymphomania (in the female) though appar ently driven to extraordinary lengths by sexual desire obtains far less pleasure (and it may be fewer orgasms) than most normal men and women do very much more easily It seems clear that in these cases the libido is not merely excessive but is also abnormal qualitatively

There are of course many factors other than psychological abnor mality which can lead to increase of sexual desire such as particularly erotic circumstances attractive and co operative partners raised tem perature (be it environmental or due to low grade fever) and so forth but these usually merely produce a moderate increase in the libido and not such a change as would suggest sexual abnormality Indeed the type of abnormality we are considering is rare both in men and women

Behaviouristic explanations of hypersexuality are meagre and un convincing The psychoanalytical view involves the Oedipus complex as usual the Don Juan type of male seeking his mother in all women but failing to find her It also invokes sado-masochistic elements—wishes to injure women and self punishment Homosexuality is a

In attempting to explain this bizarre behaviour, it is suggested that the sexual object represents the mother and is the result of conditioning which the child receives from her at an early age The adult thus becomes sexually excited only by those objects which recall this association with the mother Allen mentions the case, described by Howe, of a man who obtained sexual excitement from observing another man in *severe paroxysms of coughing* If he encountered such a person he would follow him for miles until eventually he achieved orgasm It was discovered that the patient s mother suffered from a severe cough to which he had become conditioned so as to regard it as a sexual symbol—and thus as a symbol of femininity It is not at all clear why a few men should develop this abnormal type of response

Finally we must deal with the difficult problems of inadequate or excessive sexual desire The main difficulty arises from defining what constitutes too much or 'too little'

*Sexual aversion* is manifested as impotence in the male and frigidity in the female It has already been pointed out that this is nearly always of psychological origin, but there are a few other causes which deserve mention Eunuchoids are invariably impotent and respond dramatically to testosterone administration but this hormone can be expected to have little or no effect on males whose testes are already producing adequate amounts of the substance Prolonged malnutrition leads to impotence (as seen in prisoner of war camps) as may certain diseases such as diabetes Another cause is phimosis (tight prepuce) which causes pain on erection so that, by a process of conditioning erection eventually fails to occur Impotence may be associated with absence of libido—as in all the organic causes mentioned above except phimosis or the libido may not be affected In the latter case spontaneous erections, and perhaps nocturnal emissions may occur but the patient complains that he is unable to erect when he wishes to have coitus, or that the erection subsides before he can achieve orgasm This sort of case always has a psychological basis The so-called impotence associated with premature ejaculation has already been fully discussed

Psychological impotence usually arises as a form of negative conditioning through repression of the sexual instinct during its natural development in childhood and adolescence Thus most impotent men and frigid women come from families in which sex was regarded as strictly taboo and perhaps more or less disgusting Impotence may also follow the unhappy termination of a love affair or some incident of a sexual nature which produced a shock to the patient The writer has

seen a case wherein normal intercourse occurred between a man and woman before they were married but when after marriage the woman told her husband that she had previously had intercourse with other men he became impotent Conscious or unconscious psychic homo sexuality is also a cause of impotence as are certain frank psychoses such as depressive states

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frequent characteristic of hypersexual women, who thereby are led to become active rather than passive in pursuit of sexual gratification psychoanalytically such a woman is seeking a father substitute and her intense sexual urge is thus unconsciously incestuous The obsessional element which recurs so much among the sexual perversions is again manifest Prostitution may but more commonly does not spring from hypersexuality Frank psychosis such as mania or schizophrenia in some of its later stages may be found in association with sexual insatiability

When one considers how complicated is the pattern of sexual development from infancy to adulthood at how many stages and through how many influences it can be arrested diverted or caused to regress how far from the truth are the popular views on sex and how unaware the average person is of the extent and nature of the sexual activities of his next door neighbour let alone more distantly dwelling men and women how the sexual mores vary in different times communities and social levels and how actual sexual practices commonly differ markedly from the tacitly accepted standards for the group, it is scarcely to be wondered at that sexual disorders of all kinds are common and indeed because the whole subject is so hemmed in with taboo far more common than any stati tics will be able to show There is not the slightest doubt that better knowledge on sex by the general public will go far to reducing the frequency of these disorders and the misery they engender Many of the minor disorders arouse fears in those who suffer from them out of all proportion to the actual disability simply because of ignorance and failure to realize how little removed from normal the patient really is Fear alone and the generally negative reaction to sexual disorders hinders many sufferers from seeking treatment and ignorance of the potentialities of treatment at the hands of experienced practitioners keeps yet others away from seeking help The violent aversion generally aroused by sexual perversion leads to the infliction of savage penalties sometimes perhap on those who deserve them but more often on those who need *treatment* not punishment True enlightenment is entering the courts in their dealings with sexual offenders but slowly and far from uniformly Not until there is a better balanced healthier outlook on sex by the general public can it be expected that a rational attitude free from vindictiveness will be shown by the law By then however it is likely that sexual offences would themselves have become far le s frequent

# APPENDIX I

# ANATOMY OF THE REPRODUCTIVE ORGANS

## GENERAL ANATOMY OF THE ADULT MALE AND FEMALE

Although this section of the book is concerned primarily with a description of the male and female reproductive organs a brief account may first be given of certain aspects of the general anatomy of adult men and women so as to draw attention to the main structural differences These affect principally the skeleton the muscles and the skin with its appendages

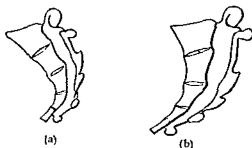
The male skeleton is on the whole larger stronger and heavier than that of the female The most distinct sexual differences are to be found in the pelvis since in the woman this is modified for the special function of childbearing Indeed sex differences may be seen in the foetal pelvis as early as the third or fourth month of foetal life They are less marked in childhood and become fully developed only after puberty The essential differences are found in the so called pelvis minor or true pelvis which in the female is wider in all diameters especially in those of the outlet so that it is less funnel shaped than that of the male At the same time the cavity is shorter There are many differences in detail but one feature alone is sufficient to enable a diagnosis of the sex of a pelvis to be made namely that the pubic arch of the female is wider its apex is rounded and it will accommodate a right angle in the male it is less than a right angle and the apex is somewhat pointed The sacrum that is the fused five pieces of the vertebral column included in the pelvis also shows distinct sex differences in the male its curve is uniform whereas in the female it is flat above and curved sharply forwards below In the female it is also shorter wider and set more obliquely than in the male

The femur or thigh bone shows minor differences in the two sexes the head and the angle of the neck being smaller in women than in

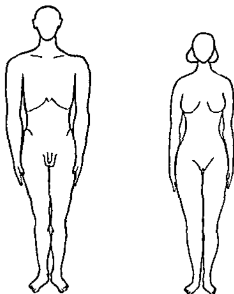
frequent characteristic of hypersexual women, who thereby are led to become active, rather than passive in pursuit of sexual gratification psychoanalytically such a woman is seeking a father substitute and her intense sexual urge is thus unconsciously incestuous The obsessional element which recurs so much among the sexual perversions is again manifest Prostitution may but more commonly does not spring from hypersexuality Frank psychosis such as mania or schizophrenia in some of its later stages, may be found in association with sexual insatiability

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The skin of a man is thicker and tougher than that of a woman it is generally more heavily covered with hair and this in turn is coarser This difference is accentuated on the face where in most women the




Median sagittal sections of (a) female and (b) male sacrum Note the abrupt curvature and the greater obliquity of the female sacrum

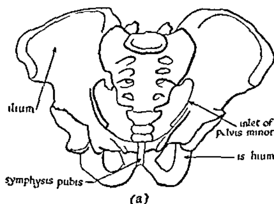


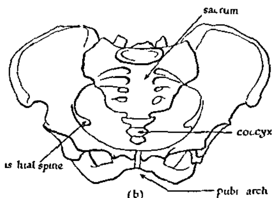
Comparative proportions of the adult male and female

hair remains very fine and downy On the scalp hair growth is more profuse and the hair is more silky in women With increasing age the tendency is to lose scalp hair in men but this is much less marked in women A distinction is often made between the distribution of pubic

men but the variations in both sexes are so great that it is difficult to be sure of the sex of any given femur

The skull of a woman is lighter than that of a man and it retains more of the characteristics of a young skull Its cranial cavity is on the average one tenth less than that of a man of the same race Various other minor features if well marked may assist in determining the sex of a skull



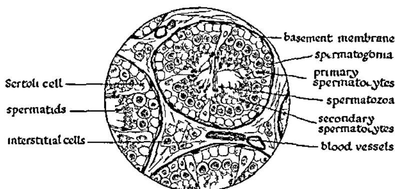

*Comparison of (a) male and (b) female pelvis Note particularly the smaller inlet of the pelvis minor and the narrower pubic arch in the male pelvis*

such as a more vertical forehead smaller jaws and teeth more rounded facial region and so on in the woman

The musculature of a man is in general better developed than that of a woman particularly in the group of muscles associated with the vertebral column—*the sacro spinalis*—and in the limb muscles There are also special differences in the muscles of the perineum of the two sexes occasioned by the different arrangement of the genital organs

appear to the naked eye as thin highly contorted threads The diameter of the tubules varies from 0 12 to 0 3 mm and their length from 70 to 80 cm (28 to 32 in) If dissected under water each tubule is seen to begin either blindly or by branching from an adjacent tubule close to the internal surface of the tunica albuginea and to pass towards the mediastinum near which the tubules unite to form a smaller number of straight tubules which open into a complicated series of canals within the substance of the mediastinum called the rete testis

The seminiferous tubules are the structures within which the formation of spermatozoa (spermatogenesis) actually takes place Each tubule is surrounded by a basement membrane of flattened cells within which there are three irregular layers of cells representing the stages of develop




Semi-diagrammatic representation of the microscopic structure of the testis

ment of spermatozoa The outer layer of large cells contains the spermatogonia which by division give rise to the primary spermatocytes These still contain the normal number of chromosomes but at the next cell division by which the secondary spermatocytes are produced this number is halved (see pp 2 15) The third layer consists of the products of division of the secondary spermatocytes the spermatids in which the development of the tail of the mature spermatozoon commences The more mature spermatids each of which becomes a spermatozoon lie towards the centre of the tubule In addition to the cells just described all of which are germ cells in various stages there are large pyramidal cells the bases of which are disposed among the spermatogonia with the apices consisting of attenuated web-like material, projecting inwards and interlacing near the centre of the tubule These are the Sertoli cells the exact function of which is a matter of debate It had

hair in the two sexes the upper border being described as concave in *women and convex in men in whom the hair often reaches to the* umbilicus Though such a difference is characteristic it is doubtful whether any significance whatever is to be attributed to a so called male distribution of pubic hair when found in a woman

The subcutaneous fatty tissue tends to be thicker in women than in *men and this, together with the smaller muscles* gives a more rounded less angular contour to the woman

The wider shoulders and narrower hips of the man and the general differences in contour between the sexes are illustrated in the accom panying figure (p 223)

## SPECIAL ANATOMY OF THE ADULT MALE

*The testis* The primary sex organ of the male is called the testis It is an ovoid structure averaging some 3 7 cm × 2 5 cm × 2 2 cm ($1\frac{1}{2}$ in × 1 in × $\frac{7}{8}$ in) but great variations in size are encountered in normal men Estimates of the functional capacity of the testis made on the basis of its size are apt to be very misleading The supporting struc

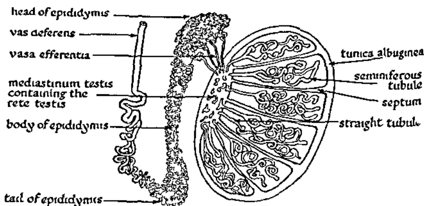


Diagram of the testis and epididymis

ture of the testis consists of a tough fibrous outer coating called the tunica albuginea from which thin fibrous bands or septa pass inwards *towards the posterior part where the tunica is thickened to form the* mediastinum testis By means of the septa the testis is divided into small compartments called lobules of which there are some 200–400 Within each lobule there are two to four seminiferous tubules which

the germinal epithelium is congenitally absent though the Sertoli cells are present

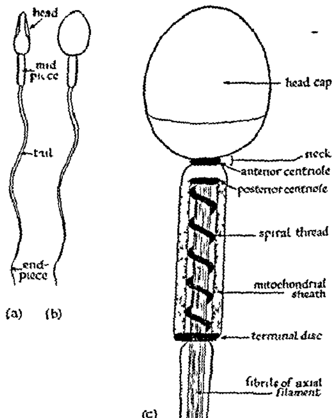
The mature spermatozoa which may be found within the centre of the seminiferous tubule are greatly modified cells equipped for the two functions of motion (so that they may travel to the vicinity of the ovum) and fertilization Each consists of a head most of which is derived from the nucleus, an ill-defined neck where the head joins the mid piece and a tail which extends from the mid piece The head is normally ovoid in shape but flattened so that in profile it presents an elongated pear shape Over the anterior two-thirds extends the head-cap The mid piece appears as the somewhat thickened commencement of the tail It is said to have a complex structure shown diagrammatically in the figure It will be seen that the axial filament of the tail commences at the posterior centriole the anterior centriole lying at the junction of head and neck Surrounding the central filament is the spiral thread and out side this is the mitochondrial sheath At the distal end of the mid piece is the terminal disc The tail consists of the axial filament around which a thin protoplasmic sheath extends to within a short distance of the tip the uncovered axial filament at the tip is called the end piece The axial filament itself consists of 9–12 fibrils All these details of the structure of spermatozoa have been elucidated with the ordinary microscope the electron microscope though possessing far greater resolution and able to achieve much higher magnifications has done little more than con firm them This must be regarded as a great tribute to the older anatom ists and to their painstaking observations with what would now be regarded as rather primitive instruments

The total length of the spermatozoon is between 52 and 62 $\mu$ (1 $\mu$ or micron is one thousandth of a millimetre) of which the head measures 4 to 5 $\mu$ the mid piece about 6 $\mu$ and the tail 41 to 52 $\mu$

Within each lobule of the testis the seminiferous tubules are loosely bound together with fibrous connective tissue in which run blood vessels nerves and lymphatics In this inter tubular connective tissue are found clumps of distinctive large cells containing yellow pigment granules (Reinke crystalloids) these are the interstitial or Leydig cells a most im portant component of the testis for they are the source of the male hor mone which they secrete directly into the blood stream (see chapter II)

*Epididymis* From the rete testis into which the seminiferous tubules lead some 12 to 20 fine canals emerge These are the vasa efferentia They pierce the tunica albuginea and after a short straight course they become convoluted to form the lobules of the epididymis Each efferent

been assumed that they had a mere mechanical function (supporting cells) or were in some way concerned with the nourishment of the developing spermatozoa (sustentacular cells to mention yet another synonym) in chapter II however the view has been expressed that more probably they have an internally secreting or endocrine function




Spermatozoa in (a) profile and (b) surface views (c) Enlarged diagram of the head and mid piece of a spermatozoon

In sections of normal testis the Sertoli cells are not easily recognized but in certain conditions in which the germinal epithelium is destroyed or absent while the Sertoli cells remain intact their form is readily observed Two such conditions are (1) after exposure to X rays of sufficient intensity to destroy the germinal epithelium (the Sertoli cells are much more resistant to irradiation) and (2) a variety of male sterility (first described by del Castillo Trabucco and de la Balze [24]) in which

cells which carry fine hairs called cilia on their inner surface By the beating of the cilia a current is set up within the fluid contents of the canal driving them onwards towards the vas deferens

The testis and its attached epididymis are together called the testicle

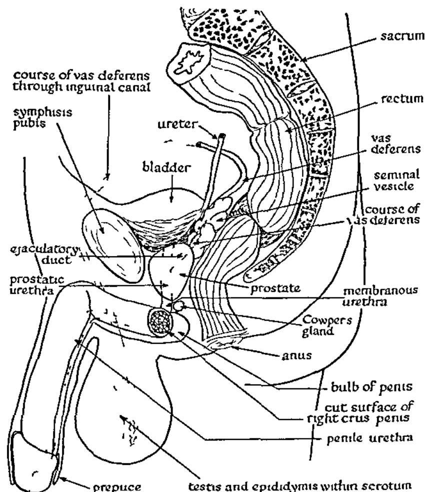
*Vas deferens* As described in the preceding section the vas deferens is the direct continuation of the canal of the epididymis At first it is very convoluted but soon it straightens out and runs upward over the posterior surface of the testis to enter the spermatic cord This latter contains along with the vas deferens the blood vessels nerves and lymphatics supplying the testicle and a muscle called the cremaster the reflex contraction of which draws the testicle upwards The cremaster muscle is of little importance in humans but in some animals which have a rutting season it serves to retract the testes from the scrotum in the non breeding season The veins of the spermatic cord are noteworthy forming a complex network called the pampiniform plexus from its fancied resemblance to a grapevine not uncommonly they become greatly enlarged and varicose giving rise to a so-called varicocele This may cause inconvenience on account of its size and weight but seems to have no other sinister significance

The spermatic cord ascends from the scrotum (p 230) and passes through an oblique tunnel the inguinal canal which runs upwards and laterally beneath the lower end of the muscles of the anterior abdominal wall Having gained the abdominal cavity the vas deferens parts company from the other structures of the spermatic cord and runs backwards into the pelvic cavity where it descends behind the bladder and approaches its fellow of the opposite side The last part of the vas widens out to form the ampulla It is now joined by the duct of the seminal vesicle and becomes the ejaculatory duct which enters the upper surface of the prostate passing forwards and downwards to open by a very fine slit into the prostatic urethra

The vas deferens has a very thick muscular wall and except in the ampulla the lumen is quite small When palpated in the spermatic cord therefore it has a firm whip-cord like feel

It will now be seen that the course transversed by spermatozoa from the seminiferous tubules in which they are developed to the urethra from which they are ejaculated is a remarkably long and circuitous one From the contorted part of the seminiferous tubule they pass into the straight tubules thence into the rete testis the vasa efferentia the epididymis the vas deferens and the ejaculatory duct before reaching the urethra

duct has a length of 15 to 20 cm (6–8 in) The efferent ducts unite to form a single canal which undergoes extraordinary convolution and forms the epididymis This structure has a head where the vasa effer




Semi diagrammatic sagittal section through a male pelvis to show the arrangement of the prostate seminal vesicles bladder and urethra

entia enter it a body and a tail from which emerges the vas deferens The latter is the direct continuation of the canal of the epididymis being distinguished from the latter by its much thicker muscular wall The canal of the epididymis when unravelled has the remarkable length of about 20 feet Lining the canal of the epididymis are columnar

to maintain the testes at a temperature lower than that of the body cavity The necessity for this extraordinary state of affairs arises because spermatogenesis will not take place at the normal body temperature and hence there occurs the phenomenon called testicular descent whereby the testes leave the abdominal cavity where they are first developed embryologically to enter the scrotum where they are maintained at a lower temperature

*Descent of the testes* Some details of this process must now be given since they will help to explain the peculiar course taken by the vas deferens It will first be necessary to consider the embryology and comparative anatomy of the uro-genital organs—urinary as well as genital for it is characteristic of vertebrates that the organs of generation and of urinary excretion are closely associated

In the division of vertebrates to which man belongs the segmental tubules from which the uro genital organs will develop group themselves into three distinct parts each with its paired ducts The foremost part the pronephros disappears after a brief embryological phase but its duct remains as the Mullerian duct which forms the oviduct or Fallopian tube of the female The middle part of the embryological kidney the mesonephros has as its duct the Wolffian duct which becomes the vas deferens in the male In some of the lower vertebrates such as the amphibians the mesonephros is the actual kidney of adult life and in the males of these animals the seminiferous tubules open by vasa efferentia (which are modified mesonephric tubules) into the tubules of the mesonephros and thence into the Wolffian duct In the higher vertebrates (including Man) a third kidney the metanephros develops in the embryo and becomes the functional kidney of post embryonic life Its duct is the ureter In the human embryo the testis starts its development in the region of the mesonephros and hence high up inside the abdominal cavity Gradually the testis comes to assume a lower and lower position in the abdominal cavity by the third month of intra uterine life it lies in the iliac fossa (within the false pelvis) and by the seventh month it is at the abdominal end of the inguinal canal In the meantime a pouch or diverticulum of the peritoneal membrane —the lining of the abdominal cavity—has grown downwards and medially through the inguinal canal towards the scrotum deriving a covering from each of the layers of the abdominal wall through which it passes This diverticulum is called the processus vaginalis and through it during the seventh month the testis passes to reach the upper end of the scrotum by the eighth month and the normal position by the time

*The scrotum* The two testicles are contained within a cutaneous pouch called *the scrotum, divided into two portions* one for each testicle Characteristically the left testicle hangs lower in the scrotum than the right Sometimes this disposition is reversed, this is usually the case in those rare individuals who have all their internal organs transposed to

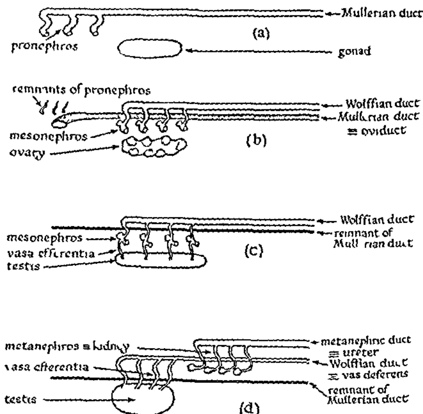
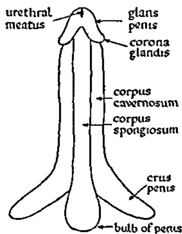
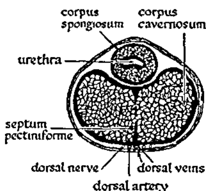



Diagram of the comparative anatomy of vertebrate uro-genital organs (a) Primitive arrangement of pronephros (b) Arrangement in female amphibian (c) Arrangement in male amphibian (d) Arrangement in male mammal (e g Man)

the opposite side (*situs inversus viscerum*) but such a situation cannot automatically be diagnosed from the relative positions of the two testicles within the scrotum The skin of the scrotum is very thin and is often thrown into folds (called rugae) by a thin muscle beneath the skin called the dartos muscle This is an involuntary (unstriped) muscle and is made to contract chiefly by cold and to relax by warmth In this way it acts as a thermostatic mechanism for the function of the scrotum is

unless the testis is in the scrotum What is more unless the testis is in the scrotum at the time of puberty that is when spermatogenesis ought to commence irreparable damage will have been done to the germinal epithelium so that even if the testis is later brought into the scrotum it will remain incapable of producing sperms If both testes remain within the abdominal cavity they may be functionless from the standpoint of producing male hormone also so that their possessor fails to achieve puberty and becomes an eunuchoid Every effort therefore should be made to bring about testicular descent where it has failed to occur spontaneously *before* the expected onset of puberty that is certainly




(a) Diagram to show the corpora cavernosa and corpus spongiosum of the penis (b) Transverse section through the shaft of the penis

not later than the twelfth year A discussion of the therapeutic problems raised by testicular mal descent is not within the province of this book but it is proper to point out that to an adult an undescended testicle is a positive liability since it becomes much more frequently the seat of a tumour than a properly placed testicle For this reason most surgeons will advise removal of a unilateral undescended testicle Obviously if both are undescended the risk will have to be borne since to remove both would render the man an eunuch

*The penis* The penis the male organ of copulation is composed mainly of a pair of corpora cavernosa and a single corpus spongiosum through which runs the urethra Each corpus cavernosum commences

the baby is born By this time the connexion of the processus vaginalis with the cavity of the abdomen is usually obliterated so that the testis lies in the scrotum within a double covering of peritoneum called the tunica vaginalis

In connexion with the descent of the testis another structure called the gubernaculum (= rudder) should be mentioned This is a ridge of fibro muscular tissue which develops in two distinct sections on the posterior wall of the embryonic abdomen The upper end becomes attached to the testis while the lower part is related to and covered by the peritoneum of the processus vaginalis The gubernaculum is at its

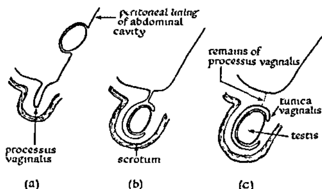



Diagram to illustrate descent of the testis (a) Testis in abdominal cavity covered (except behind) with peritoneum processus vaginalis projecting into scrotum—condition at about the 6th month of foetal life (b) Testis has descended into scrotum processus vaginalis is still patent (c) Final condition the processus vaginalis has become the tunica vaginalis testis and its connexion with the abdominal cavity has been lost

greatest development at the sixth month of foetal life Thereafter it atrophies and shortens this shortening is thought to be a possible cause of the descent of the testis Moreover the lower end of the gubernaculum divides into a number of bundles the largest of which usually passes to the scrotum while others pass to various other places—the root of the penis the pubis the upper part of the thigh and so on Occasionally the testis in its descent follows one of these accessory bundles and so fails to reach the scrotum It is then said to be ectopic Other forms of mal descent may occur one or both testicles may remain within the abdomen or fail to complete their descent into the scrotum Un descended testicle (or cryptorchidism) is an important condition clinic ally for as has already been pointed out spermatogenesis will not occur

urogenital sinus at the base of the future penis This arrangement persists in the female but in the male the urethral opening passes progressively forwards along the shaft of the penis until eventually it reaches the extremity of that organ Sometimes this process fails in greater or lesser degree and the urethral opening (meatus) is found at some point intermediate between the root of the penis and its glans This condition is called hypospadias A skilful plastic surgeon is usually able to correct it to a considerable extent and should be given the opportunity of operating preferably soon after the child has passed the napkin stage Left untreated in the adult it may lead to infertility through inability to ejaculate the semen into the vagina

The prepuce is a structure about which there is much confused and erroneous thinking In many males it is removed by the operation of circumcision sometimes for religious ritual reasons but often for a variety of reasons which do not bear close analysis The one fact which appears to be indisputable is that circumcision performed before the age of 5 years gives absolute protection against the later occurrence of cancer of the glans penis—but it is probable that proper hygienic measures even though the prepuce be present give equal protection Small boys are often referred for circumcision because of non retractability of the prepuce this displays ignorance of the normal state of affairs for as Gairdner [*38*] has so ably shown only 4 6 per cent of newborn boys have a fully retractable prepuce the proportion increasing rapidly after six months as natural separation of the prepuce from the glans occurs He believes that only after 3 years of age does non retractability of the prepuce demand medical attention Many young boys with normally non retractable prepuces are diagnosed—wrongly —as having phimosis that is a prepuce that is too tight This disorder is actually quite rare but when it does occur may prevent proper erection and thereby cause impotence or interfere with normal sexual intercourse for this state circumcision is of course sensible treatment

*Accessory sex glands* To complete the description of the special anatomy of the male we must now consider the so-called accessory sex glands These provide the liquid portion of the seminal fluid—the seminal plasma They are the prostate seminal vesicles and the glands of Cowper and of Littre The prostate is a structure composed of glands muscle and fibrous tissue in shape traditionally compared with that of a Spanish chestnut situated beneath the bladder and through which the urethra passes on leaving the bladder It is very variable in size in adult males and after middle age often becomes greatly enlarged (benign

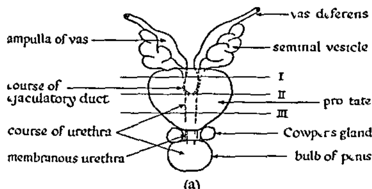
as a cylindrical structure, the crus which has an attachment to its own side of the pubic arch The two crura meet in the mid line and the corpora cavernosa then run together almost to the extremity of the penis sharing a common median septum Because this latter is incomplete nearer the extremity of the penis and has a somewhat comb-like appearance it is called the septum pectiniforme The corpus spongiosum commences in the perineum as an expanded portion, called the bulb of the penis, into which the urethra passes from the prostate gland The corpus spongiosum then narrows and passes forwards in a groove on the under surface of the paired corpora cavernosa At the extremity of the penis the corpus spongiosum expands abruptly to form the glans penis which covers the ends of the corpora cavernosa The projecting rim of the glans is called the corona

The penis is covered with very thin skin loosely attached to the underlying corpora This forms a loose fold reflected back on itself—the foreskin or prepuce—covering the glans to which it is firmly attached just proximal to the corona The surface of the glans itself is covered by even thinner skin intimately attached to the underlying structure A small median fold the frenulum passes to the deep surface of the prepuce from a point just below the opening of the urethra on the surface of the glans

The corpora are the erectile structures of the penis and are formed of cavernous tissue From the tough surrounding fibrous coat strands called trabeculae pass inwards criss-crossing so as to form a sort of sponge work The spaces between the strands are filled with blood which flows into them through very small coiled arteries running in the trabeculae and called helicine arteries When the penis is flaccid these arteries are contracted and the flow of blood is small During erection the helicine arteries relax the blood flows at greater speed and higher pressure into the cavernous spaces distending the latter and so rendering the penis erect and turgid The outflow of blood through the veins is apparently impeded by the distension of the cavernous spaces and not until the blood flow through the helicine arteries is reduced by the contraction of the latter does the outflow of blood from the cavernous spaces exceed the inflow and detumescence occur

The urethra through which urine is emptied from the bladder runs throughout the length of the corpus spongiosum The ejaculatory ducts —the direct continuation of the vasa deferentia—enter the urethra as that structure passes through the prostate In the development of the external genitalia the urethra at first opens into what is called the

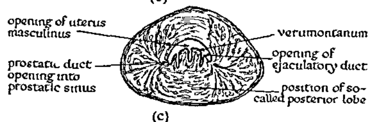
ejaculatory ducts They appear as sacculated structures variable in size lying lateral to the ampullae of the vasa deferentia behind the bladder and in front of the rectum Each seminal vesicle consists of a somewhat



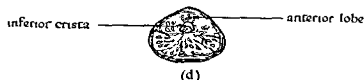

(a)




(b)




(c)




(d)

(a) Diagram of the prostate and seminal vesicles as seen from behind. Cowper s glands and part of the bulb of the penis are also included (b) (c) and (d) Transverse sections through the prostate at levels I II and III in (a) respect vely

prostatic hypertrophy) leading to difficulties in voiding urine The cause of benign prostatic hypertrophy is still unknown Some indication of the usual size of the prostate is as follows its longest or transverse diameter is 3 2–3 7 cm (1¼ to 1½ in ) its antero-posterior diameter about 2 cm (¾ in ) and its vertical diameter about 3 2 cm It is possible to feel the back of the prostate with a finger placed in the rectum—an examination which most patients find unpleasant but which nevertheless may yield information of considerable value to the doctor The urethra enters the upper surface of the prostate and passes downwards through it emerging at the lower pole nearer the anterior part In section the prostatic urethra appears as a U shaped slit because its posterior wall is bulged forward as the crista urethralis The bulging is greater near the middle of the prostatic urethra and is there termed the *verumontanum* or colliculus seminalis to the portions above and below the verumontanum the terms *superior and inferior crista* are applied The ejaculatory ducts enter the prostate at the border between the upper and posterior surfaces they run downwards, forwards and medially to enter the urethra as small elongated slits lying on the verumontanum In between their openings a third opening can be seen this leads into a blind sac very variable in size and structure called the prostatic utricle or uterus masculinus the latter term indicating its embryologic origin and relationship to the corresponding organ in the female

The prostate is enclosed within a tough fibro muscular sheath from which irregular strands pass inwards towards the urethra where they mingle with the smooth muscle bundles which surround the latter In this way the prostate is more or less divided into some fifty ill defined lobules within which the branching glandular structures lie The glands lead into ducts of which there are 20–30 most of which open into the prostatic sinus which is the gutter lying on either side of the crista urethralis A few glands sometimes open through the anterior wall of the urethra The glands are grouped into somewhat imaginary lobes of the prostate of which only the lateral lobes are regularly represented but in some cases anterior posterior and middle lobes (the latter lying between the urethra and the ejaculatory ducts) can be made out In general the so-called middle lobe is a purely pathological structure encountered in some cases of benign prostatic hypertrophy *[103]* Particularly in the prostates of older men calcareous prostatic concretions are often found embedded in the glandular structure

*The seminal vesicles* are a pair of diverticula of the vasa deferentia, emerging from the latter just before they enter the prostate as the

testes of the male They are situated on either side of the pelvis being attached to the posterior or upper surface of the broad ligament of the uterus (p 245) by a fold of that ligament called the mesovarium This is roughly triangular in shape and presents an inner free border which is thickened and called the ligament of the ovary In appearance the ovary is of greyish pink colour ovoid in shape about 3 cm long 1 5 cm wide and 1 cm thick ($1\frac{1}{5} \times \frac{3}{5} \times \frac{2}{5}$ in ) The surface is usually

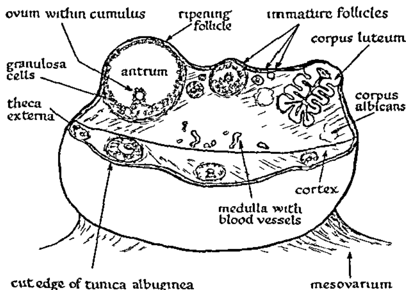



Diagram of an ovary with a wedge cut away to show some of the internal structure

irregular for a reason which will appear later The position of the ovary varies according to the posture it is also altered during pregnancy and seldom returns completely

The ovaries like the testes develop in the foetus high up on the posterior wall of the abdomen near the kidneys (see p 231) They undergo a descent which during the seventh and eighth months of foetal life carries them down to the pelvis Occasionally the descent is of an extent comparable with that of the testes in the male and an ovary may be found in the inguinal region this is usually accompanied by a hernia (rupture) and careless surgical repair of the hernia may place the ovary in jeopardy Indeed the first case of female eunuchism

tortuous tube, bent on itself, and if straightened out, may reach a length of nearly 12 5 cm (5 in ) a variable number of short, tortuous branches spring from the tube The structure of the seminal vesicle resembles that of the ampulla of the vas deferens, but its muscular wall is thinner and its glandular epithelium more highly developed The name given to this organ is a misnomer based on the erroneous belief that it stored seminal fluid In point of fact sperms are not normally present in the seminal vesicle the ampulla and the epididymis being the chief storage sites and the principal function of the seminal vesicle is now known to be the production of the sugar found in seminal fluid This sugar, which is utilized by the spermatozoa as a source of energy, was for long considered to be glucose the sugar found in the blood The elegant researches of Mann [69] however, have recently shown that it is actually *fructose* a sugar typically found in plants (fruit sugar) it appears therefore that the gland cells of the seminal vesicles possess the chemical dexterity of turning glucose from the blood into this atypical sugar

*The glands of Cowper* (bulbo urethral glands) are a pair of small bodies, each about the size of a pea placed on either side of the urethra as it passes from the prostate into the bulb of the corpus spongiosum (The glands lie between the two fasciae of the urogenital diaphragm the portion of the urethra which passes between these two fasciae is called the membranous urethra though a better term would be inter membranous urethra ) Each gland has a long narrow excretory duct by which its secretions enter the cavernous portion of the urethra

*The glands of Littre* or urethral glands are a large number of minute glands which lie within the muscular wall of the urethra and open directly into it They are most plentiful on the anterior wall but some also open on the side walls and floor of the urethra Their numbers are greatest towards the extremity of the urethra and in the so-called membranous portion

The secretory activity of the glands of Cowper and of Littre increases during erection and gives rise to the clear fluid which sometimes escapes from the urethra during sexual excitement before actual ejaculation

## SPECIAL ANATOMY OF THE ADULT FEMALE

*The ovary* The primary sex gland of the female is the ovary the functions of which are to produce eggs (ovulation) and to secrete the female sex hormones The ovaries are of course homologous with the

reason to believe that this occurs in the human and accurate investigations of rats (one of the species in which it was supposed to occur) have failed to substantiate it [65–68] Before puberty primitive follicles as described above are the only kind found in the ovary but at this period and thereafter further development of some of the follicles occurs as part of the process of ovulation (already briefly described in chapter III) As the follicle ripens the cells surrounding the ovum multiply and a cavity—the antrum—containing the liquor folliculi forms among them The ovum projects into the antrum being contained within a peninsular mass of follicle cells called the cumulus or discus proligerus the rest of the follicle cells line the antrum and form the stratum granulosum The latter is at first several layers thick but as the follicle expands it becomes reduced to one layer Surrounding the follicle a condensation of the connective tissue of the stroma forms the theca folliculi which is said to consist of inner and outer layers The developing follicles at first lie in the deeper parts of the cortex but as growth takes place they become more superficial and eventually bulge the surface giving rise to some of the irregularity of the latter previously mentioned A fully developed follicle is about 10 mm ($\frac{2}{5}$ in ) or more in diameter At ovulation one (usually) follicle bursts through the surface of the ovary liberating its contained liquor together with the ovum still enclosed within the cumulus into the abdominal cavity The subsequent fate of the ovum has been described in chapters IV and VII

During the later stages of follicle development and beginning a few days before ovulation changes occur in the granulosa cells They develop a yellow pigment and the process is therefore called luteinization Immediately after ovulation the cavity of the follicle collapses small blood vessels rupture and some bleeding occurs indeed bleeding into the antrum may begin before the follicle bursts The blood soon clots In the meantime the process of luteinization proceeds at a greatly increased rate accompanied by proliferation of the lutein cells with the formation of the corpus luteum This reaches its maximum development about 10 days after ovulation only to degenerate thereafter if fertilization has not taken place The degenerating corpus luteum becomes infiltrated with fibrous tissue and is then called a corpus albicans within two months this is reduced in size to a small scar When fertilization followed by implantation of the fertilized ovum takes place the corpus luteum continues to increase in size so that by the middle of pregnancy it may attain a diameter of about 2 5 cm (1 in ) During the later months of pregnancy the yellow colour of the lutein cells is lost

(i e the result of surgical castration) was described by Percival Scott in 1750 (quoted by Cawadias [21]) this patient had bilateral herniae which were treated by simply removing the hernial sacs (which contained the ovaries!)

The surface of the ovary is covered by a layer of cubical cells called the germinal epithelium which is continuous with the peritoneal lining of the abdominal cavity Beneath the germinal epithelium is a con densed layer of the connective tissue of the ovary called the tunica albuginea (cf the testis) Still deeper, the ovarian stroma (the connecting substance) is divided into an outer cortex characterized by the presence of ovarian follicles, and an inner medulla The stroma consists of con *nective tissue together with unstriped muscle fibres nerves blood* vessels and lymphatics In the hilus of the ovary (that is the part to which the mesovarium is attached) there may be seen small groups of large cells clustered around nerves These hilus cells resemble the inter stitial or Leydig cells of the testis and may contain similar crystalloid granules It has been suggested that they may produce male type hormones (androgens)

The ovarian follicles (Graafian follicles) contain the developing germ cells—the ova They are derived at an early stage of foetal life by the down growth of cords from the germinal epithelium on the surface These cords the egg tubes of Pfluger are actually the second series of ingrowths from the surface the first occurring in the indifferent stage (at which it is not possible to tell the sex of an embryo) and giving rise to the seminiferous tubules of the male but eventually disappearing in the female Remnants of these primary sex cords persist to a variable extent by becoming activated in adult life they may be the origin of a rare type of ovarian tumour called arrhenoblastoma which may show a structure resembling that of seminiferous tubules and which produces masculinizing effects on the patient harbouring it The primitive ovarian follicle consists of an ovum surrounded by a single layer of cubical cells enormous numbers of these are found in the ovaries of children but after puberty the number progressively decreases until after the meno pause no more are left This decrease in the number of follicles takes place in two ways the first ovulation accounts for perhaps four hun dred altogether throughout the reproductive years the second atresia (or degeneration) accounts for the remaining several thousands It had been thought that new follicles could be produced throughout the re productive years by differentiation of the epithelial cells on the surface or at least that this was true for many mammals There is very little

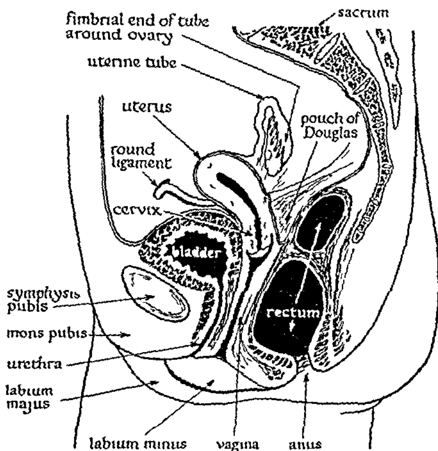
much larger its cavity being then nearly twice as long as the cervical canal In the adult woman who has not had a pregnancy the average dimensions of the uterus are 8 7 cm (3½ in ) in length 5 cm (2 in ) in breadth at its upper part and 2 5 cm (1 in ) in thickness In its most usual position the uterus is said to be anteverted and anteflexed the first term applying to the forward tilt of the axis in relation to that of the vagina and the second to the forward directed angle of the body in relation to the cervix In about 20 per cent of women however the directions are reversed the uterus then being retroverted and retro flexed

The body of the uterus (or corpus uteri) consists principally of muscle (the myometrium) and is lined with mucous membrane (the endometrium) which undergoes cyclic changes during the menstrual cycle (p 44) and which takes part in the formation of the decidua in pregnancy (p 80) Its cavity communicates below with the cervical canal the junction being the internal os while on either side at its upper end it becomes con tinuous with the Fallopian tubes The rounded portion of the body extending beyond the level of insertion of the Fallopian tubes is called the fundus and the horn like lateral extensions of the cavity where it joins the tubes are called the cornua The surface of the body of the uterus is clothed with peritoneum except at its lower anterior part where it is in contact with the bladder

The endometrium shows great variations in thickness and structure at different stages of life and throughout the menstrual cycle Before puberty it is less than 0 5 mm in thickness and consists mostly of a connective tissue stroma into which a few simple tubular glands dip from the cubical epithelium on the surface This is substantially the condition to which it eventually returns after the menopause Under the influence of the ovarian hormones however it undergoes characteristic changes In the first half of the cycle proliferative changes in the glands occur so that this phase is called proliferative (or follicular) At the end of menstrual bleeding the epithelium averages about 1 to 2 mm in thick ness The stroma is dense and has relatively few blood vessels The glands are short and quite straight They are lined by columnar cells in which numerous mitoses indicate active cell division During the suc ceeding ten days blood vessels increase in number the glands lengthen and branch in the basal layer and towards the end of this time the gland cells enlarge while their nuclei move away from the luminal border After ovulation under the superadded stimulus of progesterone secreted by the corpus luteum (see p 38) secretory changes appear so

and the corpus decreases in size so that by full term it is only about 1 cm in diameter

*The uterus* The uterus or womb is a hollow organ with thick muscular walls situated in the pelvis behind the bladder and in front of the rectum It consists of three main parts—the body, the cervix and the




Semi-diagrammatic median section through a female pelvis

uterine or Fallopian tubes Its cavity communicates with that of the abdomen by means of the Fallopian tubes and with the vagina via the cervix It is flattened from before backwards and is somewhat pear shaped, the narrow end—the cervix—being directed downwards In the infantile state the canal of the cervix is nearly twice the length of the cavity of the body, but after puberty the body becomes proportionately

broad ligament and from its posterior surface spring the mesovaria Lateral to the fimbriated end of the tube the free border forms the infundibulo pelvic ligament

Three structural layers are recognized in the Fallopian tube The outer layer is the peritoneum which is continuous with that of the broad ligament Next comes a muscular layer which is thickest in the isthmic portion of the tube The internal or mucous layer continuous with the endometrium of the uterus is thrown into complex longitudinal folds and has a ciliated epithelium The cilia play an important part in assisting transport of spermatozoa from the uterus to the ampulla of the tube where fertilization takes place while the muscular layer is responsible for the somewhat irregular peristaltic waves of relaxation and contraction which pass along the tube from the fimbriated end towards the uterus and serve to transport the ovum down the tube

*The cervix* or neck of the womb is about 2 5 cm (1 in ) in length At its upper part it is continuous with the uterus while its lower part projects into the vagina and is therefore called the vaginal portion The supravaginal portion of the cervix is separated from the bladder by connective tissue part of which surrounds the lower part of the uterus and extends within the broad ligaments (the parametrium) The vaginal portion of the cervix is rounded in outline though wide variations in size and shape are found in different women the extremes of shape are conical on the one hand and flattened or mushroom shaped on the other The canal of the cervix is continuous with the cavity of the uterus at the internal os it opens on the vaginal portion of the cervix at the external os The size of the latter is very variable being usually a few millimetres in nulliparous women but considerably or very much larger in women who have borne children In the first group of women it is usually approximately circular in shape while in the latter it is more commonly in the form of a transverse slit The canal of the cervix is wider near its middle than at either end The narrowed upper third is called the isthmus and during the second month of pregnancy it is gradually taken up into the uterus to form the lower uterine segment On the anterior and posterior walls of the canal there is a longitudinal ridge from which secondary ridges branch obliquely on either side this arrangement is accorded the fanciful title of arbor vitae It is noteworthy that in most women the cervix is normally insensitive to painful stimuli (such as pricking or cutting) but is very sensitive to stretching (as in dilatation of the canal)

*Ligaments of the uterus* These are of considerable gynaecological

that this phase of the cycle is called secretory, progestational or luteal The glands elongate very rapidly and so become cork screw shaped (because the surrounding stroma grows at a slower pace) One of the earliest changes at this stage is the appearance of vacuoles beneath the gland cell nuclei and it is generally agreed that this subnuclear vacuolation is the earliest definite evidence of the presence of a functioning corpus luteum The glands now secrete a mucoid material Still later in the cycle the extreme degree of development of the glands gives them a 'saw edged appearance in microscopical sections and three endometrial zones can be distinguished similar to those of the decidua of pregnancy a superficial zone—the stratum compactum an intermediate zone—the stratum spongiosum and a basal zone which shows few cyclical changes At this stage hypertrophy of some of the more superficial of the stromal cells may occur so that they may be transformed into decidual cells characteristic of pregnancy At this stage the endometrium may be 5 mm or more in thickness

During menstruation blood flows from damaged blood vessels in the endometrium and the superficial layers are shed piecemeal It appears that the endometrium has a double blood supply, that associated with the basal layer being unaffected by the changes in the spiral arterioles (which supply the active layers) preceding menstruation Because of this arrangement the basal layers remain intact during menstruation and from them regeneration of the glandular part of the endometrium occurs this process begins while bleeding is still taking place In this way a return is made to the stage at which this description commenced

*The Fallopian tubes* two in number are formed from the Mullerian ducts of the embryo (see p 231) and they serve to transmit the ova from the ovaries to the cavity of the uterus Each tube is some 10 cm (4 in ) long and has a funnel shaped open end near the ovary This part of the tube is called the infundibulum and is prolonged as a number of finger like processes the fimbriae (hence this end of the tube is often referred to as the fimbriated end) One fimbria longer than the rest is attached to the ovary (ovarian fimbria) The infundibulum is succeeded by a part of the tube called the ampulla this is thin walled rather tortuous and constitutes a little more than half the entire length of the tube The tube then becomes cord like with a thicker muscular wall this part being the isthmus and extending up to the wall of the uterus the remaining 1 cm of tube within the uterine wall is the intramural or uterine part

A double fold of peritoneum extends outwards from either side of the uterus the Fallopian tube lying in its free border this fold is called the

some 10 cm (4 in) The anterior and posterior walls are normally in apposition so that in transverse section it is H shaped The cervix projects through the upper end of the anterior wall forming a recess between the vaginal portion of the cervix and that wall called the anterior fornix The corresponding recess between the cervix and the posterior wall is considerably deeper and is called the posterior fornix on either side of the cervix are the lateral fornices The walls of the vagina present a series of transverse ridges called rugae Lining the vagina is a mucous membrane composed of stratified squamous epithelium extremely sensitive to oestrogens (see p 41) Gentle rubbing with a cotton wool applicator removes a few of the superficial cells which can be spread on to a glass slide (vaginal smear) and examined microscopically yielding information of considerable diagnostic value A muscular coat lies outside the mucous membrane separated from it by a thin layer of erectile tissue

*Female external genital organs* The female external genital organs collectively termed the vulva comprise the mons pubis the labia majora and minora the clitoris the vestibule of the vagina and the vestibular glands

The mons pubis is an elevation caused by a collection of subcutaneous fat overlying the symphysis pubis During puberty it becomes covered with pubic hair the upper margin of which is characteristically though by no means invariably concave

The labia majora are a pair of rounded longitudinal folds extending backwards from the mons pubis and enclosing between them the pudendal cleft The labia majora are the homologue of the scrotum in the male and among the connective tissue and fat of which they are composed there are muscle fibres similar to those of the dartos muscle (p 230) The union of the two labia in front is called the anterior commissure posteriorly there is a less distinct union the posterior commissure behind which is the anus this region is the perineum.

The labia minora are two longitudinal folds situated within the labia majora They are very variable in size in some women being concealed by the labia majora but when more extensively developed they may project outside Anteriorly they come together in the mid line and dividing into two portions they surround the clitoris (p 248) forming the prepuce and the frenulum of the latter The internal opposed surfaces of the labia minora contain numerous large sebaceous glands

The vestibule of the vagina is the cleft between the labia minora and

importance Three have been mentioned already—the broad ligaments infundibulo pelvic ligaments and ovarian ligaments There are several others

The anterior ligament joins the front of the uterus, at its junction with the cervix, to the bladder The posterior ligament consists of the recto-vaginal fold of peritoneum and passes from the back of the posterior fornix of the vagina (p 247) to the rectum so forming the pouch of Douglas or cul de sac This is bounded on either side by a crescentic fold of peritoneum called the recto uterine fold Within the recto-uterine folds there is a condensation of connective tissue and unstriped muscle forming the utero sacral ligaments The pouch of Douglas has considerable practical importance for besides being the lowest portion of the pelvic cavity, it is separated from the vagina by a comparatively thin layer of tissue Consequently it is easy to pass through the posterior fornix of the vagina into the peritoneal cavity This often happens in clumsy attempts at self induced criminal abortion with pelvic periton itis as a common result

Finally, there are the round ligaments these begin at the sides of the uterus in connexion with the ligaments of the ovary and pass laterally within the broad ligaments to the side walls of the pelvis They then proceed forwards to the inguinal canals through which they pass to end in the labia majora (p 247) The round ligaments and the ligaments of the ovary are the homologue of the gubernaculum testis in the male

*Epoophoron and Paroöphoron* Between the layers of the broad liga ment in the part known as the mesosalpinx that is between the Fallopian tube and the mesovarium there are a series of minute tubules (the epoophoron) which run from the ovary to join a similar tube (the duct of Gartner) running parallel to the Fallopian tube The epoöphoron corresponds to the vasa efferentia of the male while the duct of Gartner is a remnant of the Wolffian duct (i e the canal of the epididymis in the male) A similar series of parallel tubules situated closer to the uterus constitutes the paroöphoron, they are remnants of the more caudal mesonephric tubules of the embryo (see p 231) and correspond with the paradidymis of the male Microscopic examination is usually neces-sary to display these vestigial structures

*The vagina* This is the passage which leads from the external genital organs to the uterus It is situated between the bladder in front and the rectum behind Its lower orifice is partially closed in the virgin by the hymen It extends upwards and backwards its anterior or shorter, wall has a length of about 7 5 cm (3 in ) and its posterior wall a length of

and a frenulum continuous with the labia minora A small suspensory ligament attaches the clitoris to the symphysis pubis

*The mammary glands* The mammary glands or breasts are accessory reproductive organs their functional activity being concerned with early post natal life Each gland is situated in the superficial fascia being derived from highly modified sebaceous glands It consists of some fifteen to twenty lobes each opening by a separate lactiferous duct on the nipple Surrounding the nipple is a pigmented area of skin called the areola during pregnancy the pigmentation usually increases markedly Small nodules are often seen in the areola they are caused by the projection of underlying cutaneous glands which are believed to represent rudimentary portions of the mammary gland In the early part of pregnancy some of the nodules often enlarge and are then referred to as Montgomery s tubercles

Marked variations in the size and shape of the mammary glands are found In young girls little or no difference exists between their breasts and those of boys but shortly before puberty the duct tissue begins to proliferate under the influence of oestrogens secreted by the ovary and a small nubbin of tissue appears beneath the areola converting it to a cone During and after puberty rapid development takes place and the breast now protrudes conically from the chest wall with the nipple surmounting it on the still cone shaped areola At the end of adolescence in European and Asiatic women the sharply conical shape of the breast is lost and a more hemispherical approximation is attained associated with the development of the alveolar system (see below) the areola flattens out In some groups however such as West African Negroes the conical shape is retained to a greater or less extent The size and shape of the breasts in adult women are dependent to a large extent on the relative and absolute amounts of breast tissue and intermingled fat these in turn are much influenced by exercise nutritional state previous pregnancies and so on Exact symmetry of the breasts is rare occasionally the asymmetry is of such a degree that one breast may be quite rudimentary or grossly hypertrophied Sometimes both breasts may show one of these pathological states The presence of supernumerary glands or nipples is not uncommon—though apparently still less uncommon in men

The lobes of the gland which radiate from the nipple are separated from one another by connective tissue and fat Each lobe is subdivided into secondary lobes and lobules The lobules consist of clusters of alveoli within which the actual secretion of milk takes place during

into it open the urethra and the vagina There are also the openings of numerous small mucous glands, the lesser vestibular glands, and of the pair of greater ve tibular, or Bartholin s glands The latter are the homologue of Cowper s glands (bulbo urethral glands) in the male (p 238) and are situated one on either side of the vaginal orifice In this region is also to be found the bulb of the vestibule, corresponding to the bulb of the penis in the male It consists of a pair of rounded masses of erectile tissue, the anterior parts of which taper as they pass forward to join in front of the vaginal orifice posteriorly they overlap the greater vestibular glands

The opening of the urethra is a small orifice with puckered lips situated in the anterior part of the vestibule The vaginal orifice is behind it and in the virgin, is partially covered by the hymen a thin fold of mucous membrane The form of the latter is very variable It may completely close the vagina—imperforate hymen—so that when menstruation begins the blood cannot flow from the vagina—a painful condition called haematocolpos a simple incision with a scalpel is immediately curative It may have several small openings (cribriform hymen) a single irregular opening (the most usual form) or the opening may be so large that the hymen is virtually non existent This last entirely natural condition has led to false accusations of non virginity in unenlightened times and communities In married women the hymen is usually represented merely by a few small ragged tags on either side of the vaginal orifice—the carunculae myrtiformes (or hymenales)

The clitoris corresponds to the penis of the male and is similar to it in general structure The principal differences are in size and in the fact that unlike the penis the clitoris is not traversed by the urethra Consequently there is no corpus spongiosum (this in fact is represented by the bulb of the vestibule and the glans clitoridis to which it is attached anteriorly) Corpora cavernosa however are present and like those of the penis form the crura which are attached to the pubic arch Passing anteriorly the two crura meet to form the body of the clitoris and as in the penis a pectiniform ligament partially separates the erectile tissue of the two fused corpora The body of the clitoris is bent forwards and downwards on itself, and in all has a length of one inch to an inch and a half The extremity of the clitoris is capped, like the penis by the glans *clitoridis* This has a very sensitive epithelial covering and is the most erotically responsive part of the female genitalia, indeed in many women it is the only important erotically responsive area since the vagina is relatively insensitive As previously mentioned the clitoris has a prepuce

# APPENDIX II

## FURTHER REMARKS ON TUBAL PATENCY

Brief mention of tubal insufflation and hysterosalpingography was made in chapter XII in this Appendix further details of a somewhat technical nature are given

*Tubal insufflation* There can be no doubt that the only safe gas to use for tubal insufflation is carbon dioxide this is because unlike air or oxygen which have sometimes been used it is highly soluble in blood plasma The importance of this property comes to the fore on those rare occasions when the gas passes by accident from the uterine cavity into the uterine veins (not it should be emphasized through any negligence on the doctor s part) When such intravasation occurs no harm results if carbon dioxide has been used but if the insoluble gases have been employed the dangerous condition called embolism may be the consequence In this the bubbles of gas are carried by the circulating blood and lodge in the capillaries of vital tissues such as the lungs and brain and cause local damage or if the embolism be more extensive the blood and bubbles may be churned into a froth within the chambers of the heart thereby interfering with the action of the valves and so causing circulatory failure Because the risk of embolism small though it be increases as the procedure is carried out nearer to the start or finish of a period it is usually regarded as best to choose the mid cycle for performing tubal patency tests either by insufflation or by hysterosalpingography

The most convenient apparatus for tubal insufflation provides an adjustable flow of carbon dioxide at measured rates and records the pressure of the gas on a revolving drum (kymograph) thereby producing a permanent record of the pressures during the test The gas is passed into the uterus by means of a metal cannula with a rubber acorn inserted through the cervical canal with its tip inside the uterine cavity By drawing down the cervix with tenaculum forceps and pressing the

lactation They drain by small ducts which unite to form the lactiferous duct of that lobe Beneath the areola the ducts become dilated—the lactiferous sinuses—narrowing again as they pass into the nipple to open independently on its surface Surrounding the alveoli and ducts is a meshwork of peculiar specialized cells called myoepithelial cells because, although apparently of epithelial type they have the power of contracting like muscle fibres They serve a most important function in lactation their contraction squeezing the milk secreted in the alveoli out along the ducts (see p 130)

The information to be obtained from tubal insufflation is increased by noting the occurrence of pain which may be experienced by some patients with pathological tubes during the test and by listening in to the abdomen (auscultation) with a stethoscope The escape of gas from the fimbrial ends of the tubes is heard as a series of squeaks or bubbling noises corresponding with the downstrokes of the pressure recording pen In this way it is often possible to detect patency of one tube only no gas passing through the other The tracing in such cases is undis tinguishable from that of bilateral patency

When the patient sits up on completion of the test the gas which has passed through the tubes into the peritoneal cavity rises and accumu lates under the diaphragm provided sufficient gas has been allowed to flow Irritation of the diaphragm may cause pain referred to the shoulders (the right more often than the left) This pain when present is therefore a valuable conclusive sign of tubal patency It is seldom more than a comparatively mild discomfort and usually subsides within an hour Its non occurrence does not of course mean non patency of the tubes

Errors in the interpretation of tubal insufflation may lead to the false conclusion of either blockage or patency The commonest cause of failure of the gas to flow through the tubes is spasm which if complete gives rise to the same tracing as organic blockage To overcome this source of error some workers administer anti spasmodic drugs but the results even with such precautions are not infrequently unchanged It is probably best in all such cases to carry out hysterosalpingography after adequate sedation before concluding that the tubes are really blocked Patency may be wrongly diagnosed if a leak of gas between the cervix and the cannula allows the pressure to fall such leaks are nearly always easily detectable the escape of gas being quite audible Another potential but less likely source of error is the possibility of obtaining apparently normal peristaltic waves when bilateral hydro salpinx (the tubes being blocked but widely dilated) is present It is said that in such cases even auscultation may appear to indicate tubal patency so that only on hysterosalpingography is the true state of affairs revealed

The dangers of insufflation apart from gas embolism the possibility of which is eliminated by using only carbon dioxide are the introduction of infection and the lighting up of latent infections The first of these is of no importance since it does not arise when proper aseptic technique is used and the test is not attempted when there is obvious cervical

acorn against the vaginal surface of the cervix the operator maintains a gas tight joint between cervix and cannula The gas is allowed to flow at a rate of about 30 c c per minute if the rate be too great, the tubes may be thrown into spasm The same undesirable result may be produced by undue force exerted when passing the cannula, or by apprehension of the patient

It will be appreciated that the system formed by the insufflation apparatus, uterus and tubes is such that while gas flows into the uterus faster than it flows out the pressure will rise if the rate of outflow equals that of inflow the pressure will remain constant while if the rate of outflow exceeds that of inflow the pressure will fall When the gas is turned on the pressure rises steadily until it overcomes the tonic resistance of the tubes gas then flows through the tubes into the peritoneal cavity and the pressure usually falls If the tubes are undergoing normal peristalsis irregular rises and falls of pressure will be recorded The average pressure will depend upon the state of tonus of the tubes being high when the latter is high and vice versa Quite commonly the tubes are initially in a state of spasm, which suddenly relaxes under the steadily increasing gas pressure in such circumstances the pressure rises to a peak, falls more or less rapidly and then shows normal peristaltic waves If the spasm persists or the tubes are organically blocked the pressure continues to rise so long as the gas flows In order to eliminate the possibility of rupturing the uterus or tubes through excessive pressure a safety valve is usually fitted to the apparatus blowing off at 250 mm Hg However, most operators do not permit the pressure to exceed 200 mm Hg

Other kinds of tracings may sometimes be obtained Gas may pass through the tubes at constant pressure without evidence of peristalsis If the pressure be low it indicates atonic tubes if the pressure be high it may indicate either hypertonic tubes with failure of relaxation or stenosed (narrowed) tubes prevented from undergoing peristaltic activity by pathological changes either in the tubes themselves or in the form of adhesions binding the tubes to adjacent structures Sustained high pressure with feeble peristalsis is usually interpreted as tubal stenosis It must be emphasized that the tracing need not be constant in a given patient and it is therefore a wise rule to repeat the test whenever an abnormal result is obtained the first time It is also important that the non occurrence of peristalsis should not be accepted unless the inflow of gas has been permitted for a sufficiently long time (some minutes) to overcome the initial spasm so often encountered

which is not as unpleasant as it sounds! The patient is in place on the X ray table and when about 5 ml of medium have been injected the first film is taken while continued pressure is maintained on the plunger of the syringe More medium up to 10 ml is then injected provided undue pressure is not required and a further film is taken a few minutes later If these films do not show evidence of spill another film is taken some hours later

Tubal insufflation it will be remembered gives information of the functional state of the tubes hysterosalpingography gives information of the anatomical condition of the uterus and tubes It will thus reveal various uterine abnormalities—such as polyps or fibroids projecting into the cavity and abnormalities of development or position It will show the shape length and position of the tubes and in the event of blockage will reveal the site of obstruction Sometimes collections of opaque medium outside the tube reveal the presence of adhesions which may for example be pocketing off the ovary from the end of the tube

infection The second is more serious because of it, the test should not be performed where the history reveals the previous occurrence of utero tubal infection, or suggests it, until a prophylactic course of treatment has first been undertaken

*Hysterosalpingography* The precautions with insufflation apply equally to hysterosalpingography Three kinds of radio opaque media have been used for this investigation lipiodol an iodized oil was popular for many years non oily non viscous media, and non oily viscous media are more recent introductions Each has its advantages and its drawbacks Lipiodol produces very precise well defined shadows on the X ray film and so provides clear pictures Being viscous it may be difficult to force through spastic or stenosed tubes and immediate spill into the peritoneal cavity is seldom obtained therefore an additional film has to be taken some 24 hours after the injection so that one can see whether or no peritoneal spill has occurred If the tubes are blocked or if there are peritoneal pockets around the ends of the tubes the medium may remain *in situ* for years and produce low grade inflammatory reactions The non oily watery media have the advantage of flowing very easily but give rise to poor X ray shadows and consequently provide ill defined pictures They may be satisfactory when used in conjunction with screening the operator observing the medium as it flows through the tubes and into the peritoneal cavity An objection to screening however is that the dose of X irradiation to which the patient is unavoidably subjected may reach dangerous proportions The non oily viscous media can produce pictures almost as good as those with lipiodol pass in general more easily through the tubes and provide much earlier evidence of spill The great advantage of the non oily media is that they are rapidly absorbed both from the uterus and tubes and still more so from the peritoneal cavity and so do not give rise to inflammatory reactions Indeed so rapid is the absorption through the peritoneum of the non viscous media that their excretion through the kidneys into the ureters and thence into the bladder is often seen in X ray pictures thereby providing further and conclusive evidence of tubal patency

The usual procedure in performing hysterosalpingography is to inject the warmed medium into the uterine cavity by means of a special syringe and cannula the latter may either be similar to that used for insufflation (though usually with a metal rather than a rubber acorn) or may be of the Leech Wilkinson pattern provided with a conical coarse screw end which is screwed into the cervical canal a procedure

*Areola.* The coloured skin surrounding the nipple of the breast
*Arrhenoblastoma* A rare tumour of the ovary which secretes androgens and so causes masculinization
*Aspermia* Absence of spermatozoa from the seminal fluid
*Atresia* Degeneration particularly applied to the fate of the great majority of the primary oocytes
*A oospermia* Absence of spermatozoa from the seminal fluid
*Bartholin s glands* *See* Vestibular glands—greater
*Birth canal* Consists of the cervix the true pelvis and the soft parts that line the pelvic cavity and close its outlet
*Blastocyst* A zygote in which a fluid filled cavity has developed within the morula.
*Breech presentation* An abnormal presentation in which the foetal buttocks not head form the presenting part
*Broad ligament* One of the uterine ligaments
*Bulbo-urethral glands* *See* Cowper s glands
*Caesarian Section* Delivery of the child by surgically opening the abdomen and the uterus
*Carneous mole* Organization of a blood clot around a missed abortion
*Carunculae myrtiformes (or hymenales)* The remnants of the hymen after its rupture
*Caul* When the foetal membranes remain intact around the foetus throughout labour the child is said to be born with a caul
*Centrosomes* Region of differentiated cytoplasm outside the nucleus which doubles before mitosis and forms the spindle
*Cervicitis* Inflammation of the cervix
*Cervix* The cervix uteri is the neck of the womb
*Chorioepithelioma* A highly malignant tumour of embryonic tissue
*Chorion* Consists of trophoblast and its associated mesoderm
*Chorion frondosum* The part of the chorion beneath the decidua basalis
*Chorion laeve* The thinned chorion beneath the decidua capsularis
*Chorionic gonadotrophin* A gonadotrophic hormone produced by the placenta
*Chromatin* A constituent (nucleo-protein) of chromosomes
*Chromosomes* The nuclear structures which carry the hereditary units or genes In the human each nucleus contains 24 pairs of chromosomes
*Cilia* Microscopic hair like structures which by their lashing can set up currents in the surrounding fluid
*Climacteric* The phase of waning reproductive function
*Clitoris* Part of the female external genitalia corresponding with the penis in the male
*Coitus interruptus* Coitus in which the male withdraws prior to ejaculation
*Coitus reservatus* Prolongation of coitus by the avoidance of male orgasm
*Colliculus seminalis* *See* Verumontanum
*Colostrum* The material secreted by the breasts during pregnancy and especially in the first few days after delivery before the production of milk commences
*Commissure* The union of the labia majora in front is called the anterior commissure and behind the posterior commissure

# GLOSSARY

*Accessary glands* Secondary sex glands which provide secretions within the reproductive tract but not the germ cells themselves

*Accidental haemorrhage* Partial detachment of the placenta with resultant bleeding

*Adrenal cortex* The outer part of the adrenal gland

*Adrenal gland* An endocrine gland which lies above each kidney It consists of an outer cortex and inner medulla

*Adrenal medulla* The inner part of the adrenal gland

*Adrenalin* A hormone secreted by the adrenal medulla

*Adrenarche* The time at which the adrenal cortex becomes more active particularly in the production of androgens it corresponds with puberty

*Adrenocorticotrophic hormone* (A C T H ) A pituitary hormone which affects the cortex of the adrenal gland

*Afterbirth* The placenta and foetal membranes expelled from the uterus after the baby

*Agalactia* Failure of milk secretion by the breast

*Allantoic canal* The diminutive representative of the allantois in the human embryo

*Allantois* An embryonic structure well developed in reptiles birds and many mammals but vestigial in the human

*Alveoli of breasts* The gland spaces into which the milk is secreted and whence it passes into the ducts

*Amenorrhoea primary Failure of commencement of the menstrual periods*

*Amenorrhoea secondary* Cessation of the menstrual periods other than at the menopause

*Amnesics* Drugs which obliterate the memory of events occurring while under their influence

*Amniotic cavity* The fluid filled cavity within which the embryo develops

*Ampulla of vas deferens* The widened final part of the vas

*Anaesthetics* Drugs which produce unconsciousness as well as preventing pain

*Analgesics* Drugs which prevent pain

*Androgens* Male type sex hormones

*Androgynism* Minor intersexuality in the female

*Anovular cycles* Menstrual cycles in which no ovulation takes place

*Anteflexion* Forward directed curvature of the uterus

*Anteversion* The forward tilt of the uterus found in 80 per cent of women

*Antrum* The cavity filled with liquor folliculi which forms within the developing ovarian follicle

*Arbor vitae* The pattern of the endocervix

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*Colostrum.* The material secreted by the breasts during pregnancy and especially in the first few days after delivery before the production of milk commences

*Commissure* The union of the labia majora in front is called the anterior commissure and behind the posterior commissure

*Condom* The male sheath type of contraceptive
*Contracted pelvis* Deformity of the bones of the pelvis reducing some of the diameters of the true pelvis
*Coprophagia and coprophilia* A sexual perversion in which pleasure is obtained by eating faeces
*Cornu* The upper outer corner of the uterus where the uterine tube is attached
*Corona—of glans penis* The rim of the glans
*Corona radiata* The innermost layers of the cumulus
*Corpus albicans* A degenerated corpus luteum
*Corpus cavernosum* A paired structure forming part of the penis and clitoris
*Corpus luteum* The yellow body which forms within the ovarian follicle following ovulation and which secretes oestrogen and progesterone
*Corpus spongiosum* A part of the penis through which the urethra runs
*Corpus uteri* The body of the uterus
*Cotyledons* Lobes of the placenta
*Cowper s glands* A pair of accessory glands lying below the prostate and opening into the urethra between its prostatic and penile parts
*Cremaster muscle* This is contained within the spermatic cord and its contraction draws the testicle upwards
*Crista urethralis* The bulge on the posterior wall of the prostatic urethra
*Cross birth* The malpresentation when the foetus presents by the shoulder
*Crus* The part of the corpus cavernosum which is attached to the pubic arch
*Cryptorchidism* The condition of undescended testicles
*Cul de sac* *See* Pouch of Douglas
*Cumulus* The mass of follicle cells surrounding the ripening ovum within the follicle and still around the newly liberated ovum after ovulation
*Cunnilinctus* Application of the mouth to the female genitalia
*Cystocele* A condition in which the front wall of the vagina is stretched and lax
*Dartos muscle* A thin sheet of muscle lying beneath the skin of the scrotum
*Decidua* The endometrium after it has undergone the changes which follow upon implantation of the fertilized ovum
*Decidua basalis* The part of the decidua between the embedded ovum and the muscular wall of the uterus
*Decidua capsularis* The part of the decidua which overlies the embedded ovum
*Decidua parietalis* The part of the decidua which lines the uterus other than at the implantation site of the ovum
*Decidual cells* Large polygonal cells found in the interglandular stroma of the decidua
*Diaphragm vaginal* A contraceptive appliance also known as a Dutch cap
*Diploid* In most cells the chromosomes are paired the chromosome number being called diploid as contrasted with the haploid number (halved) in the gametes (q v)
*Draught* The reflex expulsion of milk from the breast (also called let down')
*Duct of Gartner* A vestigial tubule in the female corresponding to the canal of the epididymis in the male
*Dutch cap* *See* Diaphragm vaginal

*Dysmenorrhoea* Painful menstruation
*Dystocia* Abnormal mechanism of labour
*Eclampsia* Toxaemia of pregnancy with fits
*Ectopic pregnancy* A pregnancy developing elsewhere than in the uterine cavity
*Efferent ducts* The seminiferous tubules lead via the efferent ducts into the epididymis
*Ejaculatory duct* The vas deferens is joined by the duct of the seminal vesicle and then passes as the ejaculatory duct to the prostate to open into the prostatic urethra
*Embolism* A condition wherein solid particles or bubbles of gas are present in the blood stream
*Embryo* The developing individual before birth (or hatching) the embryo of a mammal is called a *foetus* when the main features have developed—in man after about two months
*Endocervix* The membrane lining the cervical canal
*Endometrium* The lining membrane of the uterus
*Eonism* See Transvestism
*Epididymis* Part of the duct through which the spermatozoa pass on leaving the testis it consists of a highly convoluted tube about 20 ft in length
*Epiphyses* The growing points of the bones
*Episiotomy* A cut made in the stretched perineum during childbirth to prevent tearing
*Epoophoron* Vestigial tubules in the female corresponding with the vasa efferentia in the male
*Equatorial Plate* In mitosis the chromosomes before separating into two groups become arranged in the equatorial plate across the equator of the spindle
*Erosion of cervix* Overgrowth of the endocervical tissue on to the vaginal surface of the cervix (usually with secondary inflammation)
*Eunuch* A castrated male
*Eunuchoid* Individuals (male or female) deficient in the appropriate sex hormones
*Exhibitionism* Exposing oneself to obtain sexual pleasure
*Fallopian tubes* *See* Uterine tubes
*Fascia superficial* The tissue (mostly fatty) immediately beneath the skin
*Fellatio* Application of the mouth to the penis
*Femur* The thigh bone
*Fertile phase* The phase of the menstrual cycle when coitus is most likely to lead to conception
*Fertilisation* The transmission of spermatozoa to the ovum and the union of the former with the latter leading to the development of the ovum into an embryo
*Fetishism* The substitution for the normal sexual object by another related to it but totally unfit for the normal sexual aim
*Fibrinolysin* An enzyme which breaks down the protein called fibrin
*Fimbrial end of uterine tube* The outer fringed end of the tube
*Fluor seminalis* Outflow of seminal plasma from the vagina after coitus

*Foetal membranes* These consist of the amnion chorion laeve and superficial part of the decidua parietalis
*Foetus* Embryo which has assumed a distinctly human form
*Follicle stimulating hormone (F S H)* One of the pituitary gonadotrophic hormones
*Fontanelle anterior and posterior* Expansions of the sutures in the foetal skull
*Forceps obstetric* Instruments used for assisting delivery of the baby in certain cases of difficult labour
*Formative mass* The cell mass of the blastocyst from which the embryo will later develop
*Fornix* The upper part of the vagina between the cervix and the vaginal wall There are anterior and posterior and two lateral fornices
*Free martin* A form of female intersex found in cattle when male and female twins exist together in utero and their placentae are partially fused. Human free martins are unknown
*Frenulum* A fold of skin attached to the prepuce
*Frotteurism* A perversion in which sexual pleasure is obtained by contact with other persons
*Fundus uteri* The top of the uterus
*Gametes* Germ cells—spermatozoa in the male and ova in the female
*Glans clitoridis* Corresponds in the female to the glans penis of the male
*Glans penis* The expanded extremity of the corpus spongiosum of the penis
*Glucose* The sugar found in the blood
*Gonadotrophins* Hormones which affect the gonads
*Gonads* The primary sex glands—testis in the male and ovary in the female—wherein the germ cells are produced
*Graafian follicle* *See* Ovarian follicle
*Granulosa cells* Certain of the cells forming the ovarian follicle
*Granulosa lutein cells* Luteinized granulosa cells showing the effects of luteinizing hormone
*Gubernaculum* A fibro muscular structure which develops in association with gonadal descent In the female part of it forms the round ligament of the ovary
*Gynandrism* Minor intersexuality in the male
*Haematocolpos* Retention of menstrual blood within the vagina due to imperforate hymen
*Haematometra* Retention of menstrual blood within the uterus when the latter does not communicate with the vagina
*Haploid* The germ cells carry half the chromosomes of normal body cells this number of chromosomes is called haploid
*Helicine arteries* Arteries through which blood flows into the cavernous spaces of the erectile tissue of the penis
*Hermaphrodite true or gonadal* An intersex having either an ovotestis or an ovary and a testis
*Hilus cells* Cells within the ovary which resemble the intestitial cells of the testis
*Hilus of ovary* The part of the ovary to which the mesovarium is attached

*Hirsutism* The excessive development of hair other than on the scalp
*Hormone* A substance secreted by a gland (endocrine gland) into the blood and causing activity of specific organs to which it is carried by the circulating blood
*Hyaluronic acid* A component of the jelly like cement substance of the cumulus
*Hyaluronidase* An enzyme present in seminal fluid being carried by spermatozoa
*Hydatidiform mole* A disease of pregnancy in which there is overgrowth and degeneration of the chorionic villi
*Hydramnios* Excess of liquor amnii
*Hydrocephalus* A foetal abnormality in which the head is greatly enlarged owing to accumulation of fluid within the ventricles of the brain
*Hydrosalpinx* A distended fluid filled uterine tube
*Hymen.* The membrane which partially closes the vagina in the virgin
*Hyperemesis gravidarum* Excessive vomiting of pregnancy
*Hypnotics* Drugs which promote sleep
*Hypogonadism* The condition in which the gonads are functioning inadequately in respect of sex hormone production
*Hypospadias* A defect of embryological origin in which the urethra opens along the shaft instead of at the end of the penis
*Hypothalamus* A part of the brain which exerts a control over many of the unconscious functions of the body and particularly over the activity of the pituitary gland.
*Hysterosalpingography* A liquid opaque to X rays is injected through the cervix into the uterus and tubes and X ray pictures are taken showing up the shape of the reproductive tract
*Impotence* Inability of the male to achieve erection of the penis
*Incest* The mating of persons within forbidden degrees of relationship
*Infantosexuality* The use of immature persons as sexual objects
*Infundibulum* The funnel shaped outer end of the uterine tube
*Inguinal canal* The tunnel through the abdominal wall in the groin Through it the testicle passes during its descent into the scrotum
*Insufflation of uterine tubes* A test of tubal patency in which a gas is passed through the uterus and tubes and its pressure changes recorded
*Intersex* An individual incompletely differentiated into the male or female sex
*Intestitial cell stimulating hormone* One of the pituitary gonadotrophic hormones (also called luteinizing hormone or L H)
*Introitus* The entrance into the vagina
*Isthmus uteri* The part of the uterus adjoining the internal os of the cervical canal
*17 Ketosteroids* Substances having a ketonic group attached to the 17-carbon atom of the steroid nucleus
*Kymograph* A tracing as of the pressure of gas during tubal insufflation
*Labia majora* Folds of skin connective tissue and fat which enclose between them the pudendal cleft.
*Labia minora* Longitudinal folds of tissue within the labia majora

*Labour* The muscular contractions which bring about expulsion of the baby at its birth

*Labour, premature* Labour occurring after the 28th week of gestation but before full term (40 weeks)

*Lactation* Secretion of milk by the breasts *See* Breast feeding

*Laparotomy* Surgical opening of the abdomen

*Levator ani* A funnel shaped sheet of muscle forming the most important part of the pelvic floor

*Leydig cells* Interstitial cells lying between the seminiferous tubules of the testis and believed to be the source of the male hormone

*Libido* The desire for sexual activities

*Lightening* The descent of the uterus and its contents 3 or 4 weeks before labour

*Lipiodol* An oily radio opaque medium It is now rarely used for hystero salpingography

*Liquor amnii* The fluid within the amniotic cavity

*Liquor folliculi* The fluid within the follicular antrum

*Lithopaedion* A stone child—the mummified remains infiltrated with calcium of a foetus developing outside the uterus after absorption of the amniotic fluid

*Littré glands of* Accessory glands situated within the penile urethra.

*Lower uterine segment* The lower part of the uterus derived from the isthmus which develops during the latter part of pregnancy and is passive during labour

*Luteinization* The development of yellow (lutein) material within the granu losa and theca interna cells of the ovarian follicle

*Luteinizing hormone* (*L H*) One of the pituitary gonadotrophic hormones (also called interstitial-cell stimulating hormone or I C S H)

*Luteotrophic hormone* A pituitary gonadotrophic hormone probably the same as prolactin which is believed to cause progesterone production by the corpus luteum and to be concerned in milk secretion by the lactating breast

*Malpresentations* These exist when the vertex of the foetal head does not lie over the internal os of the uterus

*Mammotrophins* Hormones thought to be secreted by the anterior pituitary gland under the influence of oestrogen and progesterone and to cause development of the breasts

*Meatus* The opening of a tube such as the urethra

*Mediastinum testis* A thickened part of the covering of the testis

*Menarche* The first menstrual period in girls

*Menopause* Permanent cessation of menstrual activity

*Menstruation* The cyclical bleeding which takes place from the uterus when fertilization and the implantation of a fertilized egg fails to occur

*Mesoderm* The embryonic cell layer which gives rise to the connective tissue structures of the body

*Mesonephros* The middle group of embryological segmental kidney tubules

*Mesosalpinx* Part of the broad ligament between the uterine tube and the mesovarium

*Mesovarium.* The ligament by which the ovary is attached to the broad ligament of the uterus

*Metanephros* The hindmost embryonic kidney which becomes the adult kidney in the higher vertebrates.

*Metastases* Secondary growths derived from a malignant tumour

*Metropathia haemorrhagica.* Wholly irregular excessive uterine bleeding

*Mitosis* The usual form of nuclear division, preceding cell division in which the halves of longitudinally split chromosomes constituting a nucleus separate into two identical groups which form two daughter nuclei. (Contrast reduction division)

*Mittelschmerz.* Mid-cycle pain at the time of ovulation

*Mons pubis* The swelling overlying the pubic bone more marked in the female than in the male

*Montgomery s tubercles* Prominent sub-areolar sebaceous glands seen in pregnancy

*Morula.* A solid mass of cells formed by division of the fertilized egg

*Mullerian ducts* The embryological forerunners of the uterus and tubes

*Multipara.* A woman who has previously borne children

*Myoepithelial cells of breast* Cells lining the ducts which can contract like muscle cells.

*Myometrium.* The uterine muscle

*Nipples supernumary* Nipples in excess of the normal pair (corresponding with the multiple nipples of some other animals e g bitch sow etc.)

*Nubile* When a girl is ovulating, she is said to be nubile.

*Nymphomania* Excessive sexual desire in the female

*Occipito-anterior* The normal position in which the foetal head engages in the pelvis the occiput being directed towards the mother's front.

*Occipito-posterior* A malposition in which the occiput of the foetal head is directed towards the mother s back.

*Occiput* The hind most part of the head.

*Oedema.* Accummulation of fluid within the tissues

*Oestradiol* One of the oestrogenic ovarian hormones believed to be the true female hormone

*Oestriol* One of the oestrogenic ovarian hormones, believed to be derived from oestradiol

*Oestrogens* Female sex hormones.

*Oestrone* One of the oestrogenic ovarian hormones believed to be derived from oestradiol.

*Oestrous cycle* The sex cycle of certain female mammals (such as rats bitches and cows)

*Oligohydramnios* Insufficiency of amniotic fluid.

*Oligospermia.* Semen with reduced numbers of spermatozoa.

*Oocytes primary* The precursors of the female egg-cells.

*Oogenesis* The development of egg-cells or ova.

*Orgasm* The climax of coital activity in both sexes.

*Os external and internal of cervix* The outer and inner ends of the cervical canal

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*Oogenesis* The development of egg-cells or ova

*Orgasm* The climax of coital activity in both sexes

*Os external and internal of cervix* The outer and inner ends of the cervical canal

*Osteomalacia* Demineralization of the skeleton such as may occur in pregnancy if the calcium intake is deficient

*Ovarian follicle* Each egg-cell within the ovary is surrounded by specialized connective tissue cells to form an ovarian (or Graafian) follicle

*Ovary* The female gonad or primary sex gland

*Ovotestis* An incompletely differentiated gonad part ovary and part testis as found in some hermaphrodites

*Ovulation* The liberation of mature ova by the ovary

*Ovum* The female germ cell

*Ovum trapped* Failure of release of a mature ovum from the follicle with luteinization of the follicle as though normal ovulation had occurred

*Pampiniform plexus* The veins in the spermatic cord

*Panhypopituitarism* *See* Simmonds s disease Deficiency of all the pituitary hormones As usually applied the term refers to the hormones of the anterior lobe only

*Paradidymis* A vestigial structure in the male corresponding to the paroöphoron in the female

*Parametrium* Connective tissue within the two peritoneal layers of the broad ligament

*Paroophoron* Vestigial tubules in the female remnants of some of the embryonic mesonephric tubules

*Parturition* Childbirth

*Pectiniform ligament* The membrane which incompletely separates the paired corpora cavernosa

*Pelvis* This is formed by the two hip bones (ilia pubes and ischia) and the sacrum (the lowest part of the vertebral column)

*Penis bulb of* The expanded perineal portion of the corpus spongiosum

*Perineum* The part of the body between the legs bounded by the pubis in front and the anus behind It includes the external genital organs

*Peristalsis* Waves of contraction and relaxation passing along a hollow organ (such as the gut and the uterine tubes)

*Peritoneum* The membrane lining the abdominal cavity and covering its viscera

*Pfluger egg tubes of* Cords of tissue perhaps derived from the germinal epithelium which are the origin of the ovarian follicles

*Phimosis* Tight prepuce

*Phosphorylated hesperidin* A substance claimed to be effective as an oral contraceptive it is a hyaluronidase inhibitor

*Pituitary fossa* A depression in the floor of the brain-case of the skull within which lies the pituitary gland

*Pituitary gland* An endocrine gland lying beneath the base of the brain

*Placenta* An organ which develops within the uterus during pregnancy to provide for the nourishment of the embryo

*Placenta praevia* This exists when the placenta extends partly or wholly over the lower uterine segment

*Placental barrier* The structures which intervene between the maternal blood and the foetal blood within the placenta

*Polar body* A structure cast out from the ovum during the process of matura

tion the first polar body is formed at the reduction division and the second during the second maturation division

*Polyspermy* Penetration of the ovum by more than one spermatozoon

*Post-coital test* Examination of the cervical mucus for the presence of living spermatozoa after coitus

*Pouch of Douglas* The space above the posterior fornix bounded in front by the uterus behind by the rectum and on either side by the rectovaginal folds (Also called the cul-de sac.)

*Pregnanediol* A derivative of progesterone

*Prepuce* The foreskin

*Presenting part* The part of the foetus normally the head which is forced through the cervix during labour

*Priapism* A state of continuous penile erection

*Primipara* A pregnant woman who has not previously borne children

*Processus vaginalis* A diverticulum of peritoneum which grows out through the inguinal canal in association with testicular descent

*Progestational phase See* Secretory phase

*Progesterone* A steroid hormone secreted by the corpus luteum and by the placenta

*Prolactin See* Luteotrophic hormone

*Proliferative phase* The phase of the menstrual cycle preceding ovulation

*Pronephros* The foremost group of embryonic segmental tubules

*Pronucleus* During fertilization the nucleus of the ovum is called the female pronucleus and that of the fertilizing spermatozoon the male pronucleus

*Prostate* The largest of the male accessory glands

*Prostatic utricle* A blind sac within the prostate of the same origin as the uterus in the female (also called uterus masculinus)

*Pseudocyesis* Phantom pregnancy in which the woman imagines herself to be pregnant and produces a variety of signs and symptoms suggesting the existence of pregnancy

*Pseudo hermaphrodite female* A form of intersex

*Pseudo-hermaphrodite male* A form of intersex

*Puberty* The stage of development at which the sex glands commence effective function

*Pudendal cleft* This lies between the labia majora

*Recto-vaginal fold* One of the uterine ligaments

*Reduction division (meiosis)* A double division of a nucleus accompanied by only one division of its chromosomes occurs in gamete formation hence the fact that gametes are haploid (q v )

*Relaxin* A hormone thought to be produced by the ovary during pregnancy and to cause softening of the pelvic joints

*Rete testis* A series of canals within the mediastinum testis into which the seminiferous tubules pass

*Retraction of uterus* After each contraction of labour the uterus retracts failing to relax to its previous dimensions

*Retroflexion* Backward-directed curvature of the uterus

*Retroversion* The backward tilt of the uterus found in 20 per cent of women

*Round ligaments* Ligaments of the uterus corresponding with part of the gubernaculum in the male
*Rugae* Ridges—on the surface of the vagina and scrotum
*Sacro spinalis* The main mass of muscle associated with the vertebral column
*Sacrum* The fused five pieces of the vertebral column included in the pelvis.
*Sado-masochism* A perversion in which sexual pleasure is obtained by the infliction of pain—either on others or on the pervert
*Safe period* The time during the cycle when coitus is unlikely to lead to conception used as a method of birth control
*Salpingitis* Inflammation of the uterine tubes
*Salpingostomy* The operation of making an opening in a blocked uterine tube
*Satyriasis* Excessive sexual desire in the male
*Scoptophilia* A perversion in which sexual pleasure is obtained from watching other people—either undressing or having intercourse (Also called voyeurism)
*Scrotum* The bag within which the testicles are suspended
*Secondary sexual characters* Characters whereby the sexes can be differentiated without reference to their producing either male or female germ cells
*Secretory phase* The phase of the menstrual cycle following ovulation (Also called progestational phase)
*Seminal fluid* The mixture of accessory gland secretions and spermatozoa which is emitted during ejaculation
*Seminal plasma* The liquid part of the seminal fluid
*Seminal vesicle* One of the male accessory glands
*Seminiferous tubules* Parts of the testis wherein the spermatozoa are produced
*Septum pectiniforme* This incompletely separates the paired corpora cavernosa of the penis and clitoris
*Sertoli cells* Pyramidal cells found among the germ cells within the seminiferous tubules and believed to help in the nourishment of the developing spermatozoa and perhaps to secrete hormones
*Sex chromosomes* Of the 24 chromosomes in each human cell nucleus 2 are concerned with sex determination In the female there are 2 X chromosomes but in the male 1 X and 1 Y chromosome
*Sex hormones* Hormones secreted by the sex glands (male hormone by the testis and female hormone by the ovary)
*Sexual analism* Utilization of the anus as a source of sexual gratification
*Sexual aversion* Impotence in the male and frigidity in the female
*Sexual inversion* Female behaviour in a man or male behaviour in a woman without structural abnormalities
*Sexual oralism* Mouth genital contacts
*Simmonds's disease* See Panhypopituitarism
*Spermatic cord* This contains the vas deferens and the blood vessels nerves etc supplying the testicle
*Spermatids* Immature male germ cells at a stage later than that of spermatocytes and in which development of the tail begins
*Spermatocytes* Immature male germ cells
*Spermatogenesis* The development of spermatozoa

*Spermatogonia* Primary male germ cells corresponding with primary oocytes in the female

*Spermatozoon* The male germ cell

*Spinnbarkeit* A rheological term measuring the property of a viscous fluid which permits it to be drawn out into a long thread Normal cervical mucus at the time of ovulation has this property

*Stigma* The point at which the ripe ovarian follicle ruptures liberating its contained ovum

*Stratum basalis* The inner layer of the decidua

*Stratum compactum* The outer layer of the decidua

*Stratum granulosum* The layer of follicle cells lining the antrum of the ovarian follicle

*Stratum spongiosum* The middle layer of the decidua

*Striae* White or pink lines in the skin caused by excessive stretching (as in the abdominal skin in pregnancy)

*Stroma* The supporting structure of tissues

*Sublimation* As applied to sexual activities means the substitution of non sexual interests for sexual ones

*Suppository* A preparation with a gelatine or cocoa butter base inserted into the vagina where it melts

*Sutures* The strips of connective tissue uniting the bones of the skull especially in the foetus

*Symphysis pubis* The joint between the two pubic bones

*Syncytium* A protoplasmic mass containing numerous nuclei and undifferentiated into discrete cells (such as the outer layer of trophoblast)

*Tampon medicated* A form of contraceptive inserted into the vagina

*Testicle* The testicle consists of the testis with its attached epididymis

*Testicular biopsy* The removal under anaesthesia, of a small fragment of testis for microscopical examination

*Testis* The male gonad or primary sex gland

*Testosterone* The male hormone produced by the testis

*Theca folliculi* The condensation of connective tissue surrounding the developing ovarian follicle

*Theca lutein cells* Luteinized theca interna cells.

*Thyroid gland* An endocrine gland which lies in front of the wind pipe in the neck

*Thyrotrophic hormone* (*T.S.H.*) A pituitary hormone which affects the thryoid gland

*Trabeculae* Strands of tissue as in erectile tissue

*Transvestism* Wearing the clothes of the opposite sex for sexual purposes

*Trophoblast* The outer layers of the blastocyst, by means of which the zygote burrows into the endometrium

*Tunica albuginea* The outer covering of the testis and the ovary

*Tunica vaginalis* The double peritoneal covering of the testicle derived from the processus vaginalis

*Umbilical arteries* There is a pair of arteries within the umbilical cord

*Umbilical cord* The cord by which the foetus is attached to the placenta

*Umbilical vein* There is a single vein within the umbilical cord

*Undinism* A perversion in which sexual pleasure is obtained by watching the act of urination

*Upper uterine segment* The upper, muscular part of the uterus which contracts during labour

*Ureter* The duct of the kidney

*Urethra* The tube by which urine leaves the bladder In the male it runs through the prostate (wherein the ejaculatory ducts enter it) and the penis

*Uterine tubes* The tubes (also called Fallopian tubes) down which ova pass from the ovary to the cavity of the uterus and up which spermatozoa pass to meet and fertilize the ovum

*Uterus* The womb within which the fertilized egg develops into a baby

*Uterus masculinus* *See* Prostatic utricle

*Vagina* The female front passage leading to the uterus

*Vaginismus* Involuntary contraction of the muscles surrounding the vagina

*Varicocele* Varicose enlargement of the pampiniform plexus

*Vas deferens* The canal of the epididymis is continued as a muscular tube the *vas deferens*

*Vasa efferentia* The canals by which spermatozoa leave the testis to enter the head of the epididymis

*Vaso epididymostomy* An operation—joining the epididymis to the vas deferens—to short circuit a block in the epididymis

*Vertex* The highest point of the head just behind the mid point

*Verumontanum* The middle of the crista urethralis (Also called colliculus seminalis )

*Vestibular glands greater* A pair of glands corresponding with Cowper s glands in the male opening into the vestibule of the vagina Also called Bartholin s glands

*Vestibular glands lesser* Glands of the vestibule of the vagina

*Vestibule bulb of* Erectile tissue in the vestibule of the vagina

*Vestibule of the vagina* Part of the female external genitalia

*Villi trophoblastic* Irregular strands of trophoblast separated from each other by maternal blood sinuses

*Virilism* The appearance in a woman of characteristics typical of the male

*Voyeurism* *See* Scoptophilia

*Vulva* Part of the female external genitalia

*Wharton s jelly* Primary mesoderm of the umbilical cord

*Wolffian duct* The mesonephric duct which becomes the vas deferens in the male

*X chromosome* The larger of the two sex chromosomes in males females have two X chromosomes

*X hormone* A hypothetical substance which it is believed may be secreted by the testis in addition to the male hormone testosterone

*Y chromosome* The smaller of the two sex chromosomes in males

*Zona pellucida* The clear thick cell wall of the ovum

*Zygote* The fertilized ovum

# BIBLIOGRAPHY


1 ABRAHAM K *Selected Contributions to Psychoanalysis* The International Psychoanalytical Library London 1928 (180)

2 ALLEN C *The Sexual Perversions and Abnormalities* (2nd edition) Oxford University Press London 1949 (179 211–220)

3 ALLEN E *Sex and Internal Secretions* Bailliere Tindall and Cox London 1939 (67)

4 ALLEN E and DOISY E A J Amer med Assoc **81**, 819 1923 *An Ovarian Hormone Preliminary Report on its Localization Extraction and partial Purification and Action in Test Animals* (4)

5 ANTONOV A N J Pediat 30 250 1947 *Children Born during the Siege of Leningrad in 1942* (154)

6 ASCHHEIM S and ZONDEK B Klin Wschr 7 8 1928 *Schwangerschaftsdiagnose aus dem Harn (durch Hormonnachweis)* (89)

7 AUSTIN C R Nature Lond **162** 63 1948 *Function of Hyaluronidase in Fertilization* (75)

8 AUSTIN C R and SMILES J J Roy Micr Soc 68 13 1948 *Phase Contrast Microscopy in the Study of Fertilization and Early Development of the Rat Egg* (75)

9 BARNES C S *The Cyclopedia of Medicine Surgery and Specialties* Davis Philadelphia **12** 336 *1941* (122)

10 BARTON M and WIESNER B P Brit med J 2 847 1948 *The Role of Special Diets in the Treatment of Female Infecundity* (155 157)

11 BEACH F A Physiol Rev **27** 240 1947 *A Review of Physiological and Psychological Studies of Sexual Behaviour in Mammals* (184)

12 BELLERBY C W Nature Lond **133** 494 1934 *A Rapid Test for the Diagnosis of Pregnancy* (90)

13 BENDER S Brit med J 2 409 1952 *The End results in Primary Sterility* (29)

14 BERTHOLD A A 1849 Arch f Anat u Physiol u wissensch Med p 42 *Transplantation der Hoden* (15)

15 BINGHAM H *The Sex Development in Apes* The Johns Hopkins Press Baltimore U S A 1928 (177)

16 BRADBURN G B and WEBB C F Amer J Obst Gynec 62 997 1951 *Cyclic Variations in the Endocervix* (47)

17 BREWER J I and JONES H O Amer J Obst Gynec 54 561 1947 *Studies on the Human Corpus Luteum Histologic Variations in Corpora Lutea and in Corpus Luteum Endometrial Relationships at the Onset of Normal Menstruation* (147)

18 BREWER J I and JONES H O Amer J Obst Gynec 55 18 1948 *Studies of the Human Corpus Luteum Corpus Luteum—Endometrial Relationships in Functional Uterine Bleeding* (147)

19 BROWNE F J *Antenatal and Postnatal Care* (7th edition) J and A Churchill London 1951 (99)

20 BUTT W R MORRIS P MORRIS C J O R and WILLIAMS D C Biochem J 49 434 1951 *The Polarographic Estimation of Steroid Hormones 5 Determination of Progesterone in Blood* (88)

21 CAWADIAS A P *Clinical Endocrinology and Constitutional Medicine* Frederick Muller London 1947 (68 69 240)
22 CREW F A E *Marshall s Physiology of Reproduction* 2, 741 (3rd edition) Longmans Green & Co London 1952 (67)
23 CRUICKSHANK R Arch Dis Childhood 20 145 1945 *Infection in Infancy* (132)
24 DEL CASTILLO E B TRABUCCO A and DE LA BALZE F A J Clin Endocrinol 7, 493 1947 *Syndrome Produced by Absence of the Germinal Epithelium without Impairment of the Sertoli or Leydig Cells* (64 226)
25 DÜHRSSEN A Ztschr f Geburtsh Gynak 27, 216 1893 (73)
26 DUMOULIN J G and HUGHESDON P E J Obstet Gynaec Brit Emp 58, 222 1951 *Chronic Endometritis* (147)
27 EBBS J H and MULLIGAN F Arch Dis Childhood 17 217 1942 *Incidence and Mortality of Breast and Artificially fed Infants Admitted to Hospital with Infections* (132)
28 ESCOMEL, E Pr med 47, 875 1939 *La plus jeune mere du monde* (54)
29 Family Planning Association The Safe Period (2nd edition) London 1952 (166)
30 FARRIS E J Amer J Obst Gynec 56 347 1948 *The Prediction of the Day of Human Ovulation by the Rat Test as Confirmed by Fifty Conceptions* (74)
31 FARRIS E J Amer J Obst Gynec 63 1143 1952 *A Formula for Selecting the Optimum Time for Conception* (74)
32 FARRIS E J *Human Fertility* The Author s Press Inc New York 1950 (26 138)
33 FORD C S and BEACH F A *Patterns of Sexual Behaviour* Eyre & Spottiswoode London 1952 (196 210)
34 FORRESTER WOOD W R Brit med J 2 840 1947 *Vaginal Temperature* (50)
35 FREUD S *Three Contributions to the Theory of Sex* The Nervous and Mental Disease Publishing Co New York 1930 (179)
36 FRIEDMAN M H Amer J Physiol 90, 617 1929 *Mechanism of Ovulation in the Rabbit—II Ovulation Produced by the Injection of Urine from Pregnant Women* (89)
37 GALLI MAININI C Sem med B Aires 54 337 1947 *Reacción Diagnostica del Embarazo en la que se usa el Sapo Macho como Animal Reactivo* (90)
38 GAIRDNER D Brit med J 2 1433 1949 *The Fate of the Foreskin A Study of Circumcision* (235)
39 GAIRDNER P Arch Dis Childhood 20, 22 1945 *Infantile Diarrhoea Analysis of 216 Cases with Special Reference to Institutional Outbreaks* (132)
40 GOODRICH F W and THOMS H Amer J Obst Gynec 56 875 1948 *A Clinical Study of Natural Childbirth A Preliminary Report from a Teaching Ward Service* (112)
41 GREENE R MATTHEWS D HUGHESDON P E and HOWARD A Brit J Surg 40, 263 1952 *A Case of True Hermaphroditism* (68)

42 HAMBLEN E. C. *Endocrinology of Woman* Charles C Thomas Springfield Illinois 1947 (43 61)

43 HANKINSON J Brit med J 2, 574 1947 *A Complication of Birth Control* (50)

44 HARVEY C Proc Soc Study Fertility 3 56 1951 *Fructose and Citric Acid in Human Semen* (26)

45 HERTIG A T and ROCK J Amer J Obst Gynec 58 968 1949 *A Series of Potentially Abortive Ova Recovered from Fertile Women Prior to the First Missed Menstrual Period* (92)

46 HOGBEN L. T Proc Roy Soc S Africa March 1930 (90)

47 HOWARD R P SNIFFEN R C SIMMONS F A and ALBRIGHT F J Clin Endocrinol 10 121 1950 *Testicular Deficiency A Clinical and Pathologic Study* (17 18)

48 HUXLEY A *Brave New World* Chatto and Windus London 1932 (3)

49 JACKSON M H Proc Soc Study Fertility 2 56 1950 *Round Cell Infiltration of the Endometrium* (147)

50 JOËL C A Schweiz. med Wschr 72 440 1942 *Zur Biologie der menschlichen Samenladen* (73)

51 JOLLY H Proc Roy Soc Med 44 459 1951 *Sexual Precocity* (66)

52 JONES E Brit J Psychol 13 31 1926 *Some Problems of Adolescence* (182)

53 KINSEY A C POMEROY W B and MARTIN C E *Sexual Behavior in the Human Male* Saunders Philadelphia and London 1948 (176 179 182–209)

54 KINSEY A C POMEROY W B MARTIN C E and GEBHARD P H *Sexual Behavior in the Human Female* Saunders Philadelphia and London 1953 (176 182–209)

55 KLEIN M *The Psychoanalysis of Children* The International Psycho analytical Library London 1932 (180)

56 KNAUS H Zentralbl f Gynak 59 2642 1935 *Zur Bestimmung des Ovulations und Kon eptione termines* (166)

57 KROHN P L Brit med J 1 803 1949 *Intermenstrual Pain (The Mittelschmerz") and the Time of Ovulation* (49)

58 LANCET 1 106 1933 *An Investigation of the Menopause in One Thousand Women* (59)

59 LATZ L. J J Amer med Assoc 105 1241 1935 *Natural Conception Control* (167)

60 LAUGHTON N Proc Soc Study Fertility 3 18 1951 *Observations on the Bacterial Flora of the Cervical Canal in Infertile Women with Cervical Dysfunction* (145)

61 LILLIE F R J Exp Zool 23 1371 1917 *The Free martin a Study of the Action of Sex Hormones in the Foetal Life of Cattle* (3)

62 LOESER A A Gyn Practique 2 213 1951 *The Rejuvenating and Cura tive Effect of a Combined Androgen Oestrogen Tablet in Menopausal and Ageing Women and in Other Gynaecological Ailments and an Hypothesis of Cancer Formation* (41)

63 MACLEOD J Proc Soc Study Fertility 3 69 1951 *An Analysis of the Male Factor in Fertility and Infertility* (27 29)

64 MALINOWSKI B *The Sexual Life of Savages* Kegan Paul London 1929 (178)

65 MANDL A M and ZUCKERMAN S J Endocrinol 7, 103 1951 *The Effect of Destruction of the Germinal Epithelium on the Numbers of Oocytes* (34 241)

66 MANDL A M and ZUCKERMAN S Ibid 7 112 1951 *Numbers of Normal and Atretic Oocytes in Unilaterally Spayed Rats* (34 241)

67 MANDL A M and ZUCKERMAN S Ibid 7, 190 1951 *The Relation of Age to Numbers of Oocytes* (34 241)

68 MANDL A M ZUCKERMAN S and PATTERSON H D Ibid 8, 347, 1952 *The Number of Oocytes in Ovarian Fragments after Compensatory Hypertrophy* (34 241)

69 MANN T Biochem J, 40, 481 1946 *Studies on the Metabolism of Semen 3 Fructose as a Normal Constituent of Seminal Plasma Site of Formation and Function of Fructose in Semen* (25 238)

70 MARSH E M and VOLLMER A M, Fertility and Sterility 2, 70 1951 *Possible Psychogenic Aspects of Infertility* (153)

71 MILLER D Brit med J 2 183 1928 *Observations on Unsuccessful Forceps Cases Causation Management and End results* (124)

72 NAISH C F *Breast Feeding* Oxford University Press London 1948 (131)

73 NIEBURGS H E and GREENBLATT R B Amer J Obst Gynec 57, 356 1949 *Specific Estrogenic and Androgenic Smears in Relation to the Fetal Sex during Pregnancy* (12)

74 NIXON W C W and RANSOM S G *Relief of Pain in Childbirth* Cassell London 1951 (113 114)

75 NOVAK E Amer J Obst Gynec 47 20 1944 *The Constitutional Type of Female Precocious Puberty with a Report of 9 Cases* (54)

76 NOVAK E *Menstruation and its Disorders* D Appleton & Co New York 1921 (59)

77 OGINO K *Conception Period of Women* Medical Arts Publishing Co Harrisburg 1934 (166)

78 PARKER G H Philos Trans Roy Soc B 219 381 1931 *The Passage of Sperms and Eggs through the Oviducts of Terrestrial Vertebrates* (72)

79 READ G D *Revelation of Childbirth* Heinemann London 1946 (90 100 112)

80 Royal Commission on Population 1 1949 *Family Limitation and its Influence on Human Fertility during the Past Fifty Years* (10 162 165 171)

81 Royal Commission on Population 4 1950 *Report of the Biological and Medical Committee* (149 155)

82 RUBENSTEIN B B STRAUSS H LAZARUS M L and HANKIN H Fertility and Sterility 2 15 1951 *Sperm Survival in Women Motile Sperm in the Fundus and Tubes of Surgical Cases* (73)

83 SANDLER B Proc Soc Study Fertility 3, 72 1951 *Cervical Hostility and Asthenospermia* (27)

84 SANYAL, S N Calcutta Med J 47 313 1950 *Sterility Effect of the Oil of Pisum Sativum Linn and its Relation with Vit E* (168)

85 SANYAL, S N Ibid. 48 53 1951 *Sterility Effect on the Oil of Pisum Sativum Linn* (168)

86 SANYAL S N Ibid 48 399 1951 *Sterility Effect of the Oil of Pisum Sativum Linn III* (168)

87 SANYAL, S N Ibid 49 343 1952 *Sterility Effect of Pisum Sativum (Linn) Chemical Study IV* (168)

88 SANYAL, S N Ibid 49 348 1952 *Sterility Effect of Pisum Sativum Spectrophotometric Study V* (168)

89 SANYAL, S N Ibid 49 354 1952. *Sterility Effect of Pisum Sativum (Linn) Biological Study VI* (168)

90 SHAPIRO H A. and ZWARENSTEIN H Nature Lond, 133, 762 1934 *A Rapid test for Pregnancy on Xenopus laevis* (90)

91 SIEVE B F Science 116 373 1952. *A New Antifertility Factor (A Preliminary Report)* (168)

92 SIMPKINS C. S Amer J Anat. 51 465 1932 *Development of the Human Ovary from Birth to Sexual Maturity* (34)

93 SMELLIE J M Lancet 1, 969 1939 *Infantile Diarrhoea (Ingleby Lecture)* (132)

94 SMITH C A J Pediat. 30 229 1947 *Effects of Maternal Undernutrition upon the Newborn Infant in Holland* (1944–1945) (154)

95 SMITH G VAN S and SMITH O W Physiol. Rev 28 1 1948 *Internal Secretions and Toxaemia of Late Pregnancy* (96)

96 SOLOMONS B in *The Cyclopedia of Medicine Surgery and Specialties* Davis Philadelphia 12 415 1941 (123)

97 STOCKARD C R and PAPANICOLOAU G N Amer J Anat. 22 225 1917 *The Existence of a Typical Oestrus Cycle in the Guinea Pig With a Study of its Histological and Physiological Changes* (41)

98 SWYER G I M Biochem Soc Symposia 7 34 1951 *Hyaluronidase and Fertilization* (75)

99 SWYER, G I M Brit. J Nutrition 3 100 1949 *Nutrition and Human Fertility* (154)

100 SWYER, G I M Brit. med J 2 672 1947 *Vaginal Temperature* (51)

101 SWYER G I M Ibid 2 931 1947 *Vaginal Temperature* (51)

102 SWYER G I M Fertil and Steril 4 416 1953 *Outcome of Pregnancy in Women Attending a Fertility Clinic* (29)

103 SWYER G I M J Path Bact 54 365 1944 *Some Observations on the Pathological Anatomy of Benign Prostatic Enlargement* (236)

104 TOPKINS P Amer J Obst Gynec 58 654 1948 *The Histologic Appearance of the Endocervix during the Menstrual Cycle* (47)

105 UNTERBERGER F Deut Med Wschr 58 729 1932 *Geschlechtsbestimmung und Wasserstoffionkonzentration* (11)

106 WALLER H K. *Clinical Studies in Lactation* Heinemann London 1939 (131)

107 YERKES D M and YERKES R M. *The Great Apes* Yale University Press New Haven 1929 (177)

108 ZUCKERMAN S *The Social Life of Monkeys and Apes* Kegan Paul London 1932 (177)

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Y chromosome 2 3 8 11 268

Zona pellucida 76 78 79 268
Zygote 1 3 8 77 78 268